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STOPPING WATER POLLUTION AT ITS SOURCE

MISA
Municipal/Industrial Strategy for Abatement

MONITORING COSTS AND THEIR IMPLICATIONS FOR DIRECT DISCHARGERS IN THE METAL CASTING INDUSTRY

Environment Ontario

Jim Bradley
Minister

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Monitoring costs and their implications for direct dischargers in the metal casting industry.

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MUNICIPAL-INDUSTRIAL STRATEGY FOR ABATEMENT (MISA)

(DRAFT)

MONITORING COSTS AND THEIR IMPLICATIONS FOR DIRECT DISCHARGERS IN THE METAL CASTING INDUSTRY

Socio-Economic Section
Policy and Planning Branch
Corporate Resources Division

April 1989

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REQUEST FOR COMMENTS AND SUGGESTIONS ON

MONITORING COSTS AND THEIR IMPLICATIONS

FOR

DIRECT DISCHARGERS IN THE METAL CASTING INDUSTRY

(DRAFT DATED APRIL 1989)

Comments and suggestions will be used to improve subsequent drafts of this report, and similar reports on other sectors, in terms of analysis, technical accuracy, and readability.

Please return this sheet and any comments to:

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ABSTRACT

Estimates of the incremental costs to Ontario's metal casting plants that are direct dischargers subject to the MISA monitoring regulation are derived and summarized. The regulation applies to only 12 metal casting plants out of about 300 in Ontario. Five of the 12 firms that own these plants are private companies and the other seven are public firms.

Capital and operating costs are estimated by plant for each of the six major monitoring activities.

- sampling requirements;
- characterization requirements;
- routine analyses;
- toxicity testing;
- flow measurement; and
- reporting.

The capital cost estimates and some of the operating cost estimates were provided by company officials.

Incremental capital costs for the 12 metal casting plants are estimated to be approximately $501,000, and range on a per plant basis from $100 to $238,000.

Operating cost estimates over the 12 month period range from $7,700 to $316,000 per plant, and total approximately $944,000.

Three of the larger plants account for roughly 87% of the estimated expenditures. The remaining nine operations account for the remaining 13% of potential costs.

The total estimated costs for the 12 plants for all six monitoring activities is approximately $1,445,000.

If all plants were required to monitor all effluent streams for a consistent set of parameters at the same frequency, total cost of analytical and toxicity testing for this sector would total $1.9 million. This difference represents a cost savings of $463,000 and is a measure of the cost-effectiveness of the site-specific approach adopted for this sector.

The financial impacts of the estimated monitoring costs on the metal casting plants were analyzed using historical data for the period 1982-1987.

Capital costs, when viewed in terms of average annual capital expenditures over the 1982 to 1987 period, represent between 0.001% and 2.385% of each plant's (or firm's) expenditures.

Operating costs in relation to average annual after-tax earnings, again over the same period, range from .001% to 14%.

Potential benefits to the metal casting plants required to monitor include reduction to operating costs by reducing water usage and process material losses, and goodwill gained by demonstrating to the public that the company is a good corporate citizen responding to environmental problems. In addition, the monitoring data base will be available to design cost-effective control programs aimed at the virtual elimination of toxic contaminants of their source.

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1.0 BACKGROUND AND PURPOSE OF REPORT

1.1 MISA Objectives

The MOE's Municipal-Industrial Strategy for Abatement (MISA) is intended to achieve the "virtual elimination of toxic contaminants in municipal and industrial discharges into waterways."

The MISA program consists of three broad components:

1. Development and promulgation of Regulations which specify (a) contaminant monitoring requirements, and (b) effluent limits.

2. Development of these effluent limits based on "best available technology economically achievable" (BATEA) or water quality impacts.

3. Implementation of abatement programs and enforcement activities.

Economic assessments of each component of the MISA program are also being prepared. These assessments are intended to show the costs of the various regulations and other program elements and the economic and financial implications of these costs.

The MISA program will encompass at least 200 Ontario industrial establishments which discharge contaminants directly into waterways disaggregated into nine industrial sectors:

- petroleum refining
- organic chemical manufacturing
- pulp and paper
- iron and steel
- metal mining and refining
- industrial minerals and manufacturing
- electric power generation
- inorganic chemicals
- metal castings.

The first phase of the MISA regulatory program is the promulgation of monitoring regulations for all plants within each of the industrial sectors which discharge waste waters directly into the natural environment.

All direct dischargers are subject to a "General" and "Sector Specific" monitoring regulation. The

general regulation was promulgated in June 1988 and specifies monitoring requirements which apply to all industries. Sector specific regulations are currently being developed for each industrial sector.

This investigation is part of the economic assessment component of the MISA program. The economic rationale, purpose and elements of the economic component of the program are discussed in the report "Economic Information Needs and Assessments for Developing MISA Monitoring and Abatement Requirements" (Ontario Ministry of the Environment, March 1987).

1.2 Sector Definition

The metal casting sector includes those establishments that manufacture metallic objects by cooling molten metal in a mold or die. Within this broad definition, a variety of establishments exist in this sector due to the many metals that may be used, molding techniques employed and finished products produced. The sector can be subdivided into ferrous and non-ferrous casters, die casters and foundries and even further partitioned into specific metal groups and casting techniques.

A search of association memberships, government statistics and numerous other data sources identified over 300 metal casting plants active in Ontario. Further information about the metal casting industry in Canada and Ontario can be found in the Metal Casting Industry Economic Profile (Deloitte, Haskins & Sells, 1988). A survey of these 300 odd metal casting plants, conducted by the MOE Water Resources Branch, showed that they differ significantly with respect to wastewater generation and disposal practices.

Of the 300 or so metal casting plants in Ontario, approximately 175 will not be subject to the MISA regulations since they do not produce industrial wastewater. About 113 of the remaining plants discharge only storm or cooling water to municipally or provincially owned sanitary sewers. These plants which discharge wastewaters to municipal and provincial sewers, will eventually be subject to monitoring and abatement requirements under the MISA Sewer Use Program (MOE, February 1988). The remaining 12 plants, that directly discharge their wastewater, are currently subject to the MISA Monitoring Regulation (Ontario Ministry of the Environment, March 1989).

1.3 Effluent Monitoring Regulation for Ontario's Metal Casting Plants

The twelve metal casting plants which are subject to the monitoring regulations for direct dischargers are listed in Table 1.1.

TABLE 1.1

METAL CASTING SECTOR PLANTS

OWNERSHIP	PLANT	LOCATION	NUMBER OF EMPLOYEES
Acustar Canada Inc. is a subsidiary of Acustar U.S. which is a subsidiary of Chrysler U.S.	Acustar Canada Inc. Casting Plant	Etobicoke	450
The Bowmanville Foundry Company Ltd.	Bowmanville Casting Plant	Bowmanville	62
Canron Inc., a subsidary of IVACO Inc.	Canron Inc. Hamilton Pipe	Hamilton	270
Fahramet Steel Castings Indusmin Division of Falconbridge Ltd.	Fahramet Steel Castings Indusmin Division Plant	Orillia	250
Ford Motor Company of Canada Ltd., a subsidary of Ford Motors Corporation	Ford Motor Company Windsor Casting and Engine Plant	Windsor	1,000
Franklin Electric of Canada Ltd., a subsidiary of Franklin Electric Company Inc.	Franklin Electric of Canada Ltd. Casting Plant	Strathroy	200

OWNERSHIP	PLANT	LOCATION	NUMBER OF EMPLOYEES
General Motors of Canada Limited, a subsidary of General Motors Corporation	G.M. Canada St. Catherines Metal Casting and Engine Plant	St. Catharines	2,500
Haley Industries Limited	Haley Casting Plant	Haley Station	413
Magalloy Ltd.	Magalloy Limited Casting Plant	Stratford	38
Richmond Die Casting Ltd.	Richmond Die Casting Plant	Cornwall	125
A.H. Tallman Bronze Company Ltd.	A.H. Tallman Casting Plant	Burlington	25
Western Foundry Company Ltd.	Western Foundry Casting Plant	Wingham	300

The metal casting companies will be required to submit an "Initial Report" under the reporting requirements within three months and seven days following promulgation of the Regulation. The primary requirements of the Regulation come into force five months after its promulgation. The five month implementation period is intended to provide sufficient time to allow the plant site to purchase and install equipment, negotiate contracts with laboratories, set up their monitoring programs and train personnel.

As noted, monitoring requirements for the metal casting sector are specified in two regulations:

1. "Effluent Monitoring - General" which specifies common sampling, analysis, toxicity testing, flow measurement, recording and reporting protocols and procedures for all MISA sectors; and

2. "Effluent Monitoring - Metal Casting Sector" which defines monitoring requirements specific to the metal casting.

The "Effluent Monitoring - General" regulation will continue in force for each MISA sector.

1.4 Purpose and Objectives of Present Report

The monitoring requirements have been developed during negotiations with industry representatives through a Joint Technical Committee (JTC). Cost-effectiveness has been considered in arriving at the agreed-to protocols and requirements.

This report is intended to present estimates of the potential incremental costs to the twelve metal casting plants in Ontario of implementing the sector specific and general monitoring regulations. The economic effects and financial implications of these costs on the subject firms will be analyzed where data are available.

The current monitoring regulation has gone through several iterations, resulting in a regulation that satisfies government objectives, industry concerns and public representative suggestions. Evidence of the cost-effectiveness of the proposed requirements is revealed by comparing the costs associated with the proposed plant and pipe-specific requirements with the potential costs incurred under an alternative set of requirements. These comparative estimates show the extent to which these regulations are cost-effective.

1.5 Cost Estimation Methods

Incremental costs of monitoring consist of recurring operating costs and one time capital and installation costs. In this report, capital and operating costs have been estimated for each monitoring function at each plant.

Steps involved in cost estimation include the determination of the activities and items that are required to implement each monitoring function, and the use of simplifying assumptions where necessary.

The costs of chemical analyses and biotoxicity tests were estimated by assuming that all analytical testing will be performed by commercial laboratories. Even when plants have the ability to conduct analyses on-site, this assumption was made in order to obtain comparable cost estimates for each of the plants. Consequently, in cases where a firm intends to do some or all of the testing in house, the analytical costs may be overestimated.

Single-valued or point estimates are presented, but should be treated with caution. Inputs required for different types of monitoring functions are often uncertain and there is some flexibility as to how individual plants may implement some of the monitoring requirements. Moreover, in the case of this sector, some of the plants are investigating combining streams to reduce sample points, switching from water cooling systems to air cooling, and connecting their discharges to municipal sewers so as to avoid or reduce monitoring requirements at this time.

Cost-effectiveness of the monitoring requirements has been examined by comparing the costs associated with the site and pipe specific requirements to potential costs incurred when plants are required to monitor all effluent streams for a consistent set of parameters at the same frequency.

All cost estimates are expressed in 1988 dollars.

Relevant cost tables, assumptions, and general factors used to calculate cost estimates can be found in Appendices A-E.

1.6 Pre-Regulation Consultation and Meetings

Industry representatives from the metal casting sector spent time at meetings and review committees in order to participate in the development of the regulations.

These meetings included participation on the Metal Casting Sector Joint Technical Committee (JTC) and its Analytical and Regulation Subcommittees. In addition, metal casting company staff devoted time to provide technical and cost information to Ministry of the Environment staff. Total time spent for pre-regulation assessments, consultation and meetings amounted to 861 person-hours.

Participation in these meetings may represent an opportunity cost in terms of time spent away from regular business. According to industry representatives, personnel involved in these meetings earn between $25 and $100 per hour. Valued in terms of these gross salary dollars, the cost of pre-regulation consultation and meetings would range from $500 to $11,000 per plant, not including transportation. In addition, Acustar, Ford, General Motors and Haley contracted consultants to conduct pre-regulation monitoring. The total cost spent on these consultants totalled $107,000. The total estimated cost of all monitoring, meetings and consultation for these twelve plants totalled $143,200.

However, because these employees are salaried (i.e., they are paid whether they work on MISA or on other assigned duties), the cost may be some amount less than these gross values. This will be particularly true where dealing with environmental regulations is part of the employees regular duties. Although for some plants using staff employed in a production related capacity, the opportunity cost would not only include salaries and benefits, but an expected rate of return on the company's investment in labour.

The pre-regulation costs have likely reduced some of the cost estimates for collecting information for the initial report. However, since these present no future costs to the firms directly, they have been treated as sunk costs in the following analyses.

In addition to the time spent by company officials, various foundry and die casting association representatives have contributed time to this effort. The metal casting sector is represented by three associations, however not all firms are members. The three associations that have contributed to the development of the Regulation are:

(i) The Canadian Foundry Association (CFA);
(ii) The Ontario Chapter of the American Foundrymens Society (AFS);
(iii) The Canadian Die Casters Association (CDCA).

The CFA and CDCA are business associations which represent member firms. The AFS is a technical society. For the purpose of this analysis, association costs have been assumed as part of their normal activities.

2.0 MONITORING COST ESTIMATES

2.1 Regulation Requirements

The General Effluent Monitoring Regulation specifies requirements for six major monitoring activities which each wastewater discharger must implement to various degrees and levels of effort.

1. Sampling requirements
2. Characterization requirements
3. Routine analyses
4. Toxicity testing
5. Flow measurement
6. Reporting

Five types of effluent streams or "sampling points" are defined in the specific Regulation for the metal casting sector.

1. Process effluent after final treatment,
2. Cooling water,
3. Storm water run-off,
4. Combined process effluent,
5. Combined stormwater and cooling water streams.

The monitoring schedules for the metal casting sector, which can be found in the sector-specific regulation, differ by plant according to the type of effluent stream and the manufacturing processes found at the plants. The number and types of effluent streams have been identified by type in Table 2.1.

TABLE 2.1

NUMBER AND TYPE OF EFFLUENT STREAMS BY PLANT

	Process Effluent	Cooling Water	Storm Water	Combined Process Effluent	Combined Storm Water and Cooling Water	Total
Acustar		1				1
Bowmanville					1	1
Canron		3	1		1	5
Farhamet					1	1
Ford	1			1		2
Franklin					1	1
General Motors	1			1		2
Haley	2					2
Magalloy		1				1
Richmond					1	1
A.H. Tallman		2				2
Western	—	—	—	—	2	2
TOTALS	4	7	1	2	7	21

2.2 Sampling Requirements

Sampling protocols and specifications are defined in Section 3 of the "Effluent Monitoring - General" regulation.

This function involves taking water samples from designated sampling points, collecting the samples, storing them under refrigeration where necessary and then transporting the samples to lab facilities within a prescribed time period. Samples may be required for characterization, routine analyses and for toxicity tests.

Operating expenditures may consist of the following components:

- vehicle leasing;
- transportation within plant and to laboratories;
- operating and maintenance of automatic sampling devices; and
- personnel required either for manual sampling or for collection of samples.

Personnel are required to collect samples. The wage rates cited for relevant personnel ranged from $11.00 to $30.00 per hour. Consequently, personnel costs for manual sampling or collection of automatic samples for the plants ranged from $400 to $33,000 (Ford) per plant.

Another component of the operating costs is the transportation of the samples to the laboratories. Only Ford and General Motors cost estimates include company personnel for transportation. The other companies have estimated the cost of transportation assuming the use of a courier. MOE has estimated transportation costs to be $1,000 per sampling point over the 12 month period of the regulation for those companies failing to provide their own estimates. This estimate is based on courier transportation costs submitted by other metal casting plants. For those firms which provided estimates transportation costs ranged from $300 to $3,600. The cost estimates for using personnel for Ford and General Motors were $22,000 and $19,000 respectively. These costs will likely be reduced by contracting a laboratory to pick-up the samples, which can be coordinated with current sample deliveries.

Another operating cost element is maintenance and calibration of sampling equipment. These costs are associated with those plants using automatic samplers. The estimates for this cost element range from $1,600 for General Motors and Haley to $6,000 for Ford. However, Ford's estimate also includes the maintenance and calibration of flow measurement equipment.

The remaining operating cost estimates provided for the sampling activity were $1,000 contingencies for General Motor and Haley estimates.

In total, operating costs for sampling range from $1,400 to $60,000 per plant per year, with a total estimate of $155,920 for the 12 plants. The range of costs per plant reflects the number and frequency of the effluent streams that must be sampled at each plant.

Capital expenditures for sampling may include equipment, installation and construction costs.

Equipment that may be required include automatic samplers, refrigeration units for the automatic samplers and for storage, insulated enclosures and transmission systems.

The cost of refrigeration units for automatic samplers are usually included in the costs of the automatic samplers.

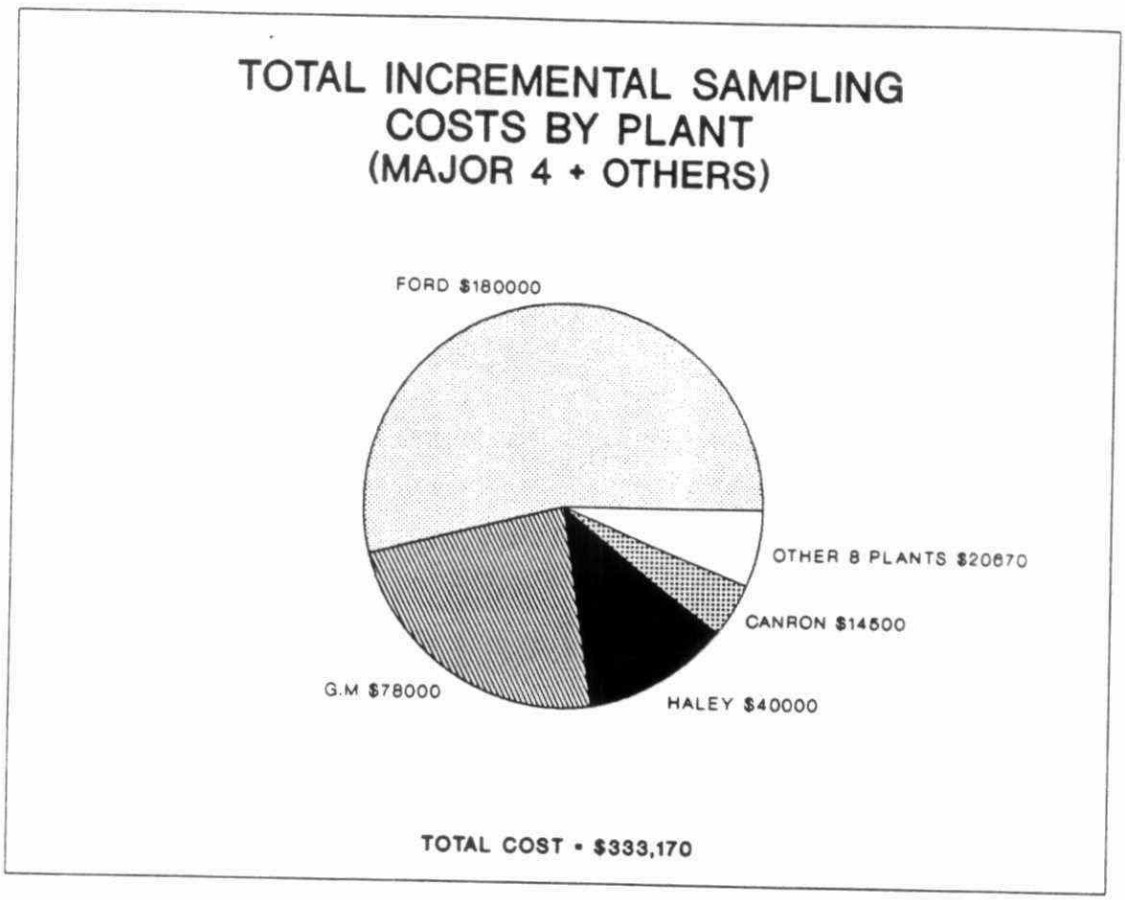
For the purpose of this analysis it was assumed that all companies required to do toxicity testing should factor into their estimates the cost of a refrigerator. Therefore, an estimated cost of $1,500 was used for those companies that did not factor this into their cost estimates.

Installation costs of a sampling facility, which includes temperature recorders, electrical supply, signal cables and construction are sensitive to site specific circumstance. Installation costs can amount to as much as two times the equipment cost.

Capital cost estimates were supplied by each plant and reviewed by MOE technical staff. As shown in Table 2.4, the costs range from $100 to $120,000 (Ford) per plant. This wide divergence is due primarily to the number of effluent outlets at each plant as well as the number of devices which plants intend to install, and costs associated with installing the devices.

The estimate of the total capital expenditure for sampling for the 12 plants is $177,250.

FIGURE 2.1


TOTAL INCREMENTAL SAMPLING
COSTS BY PLANT
(MAJOR 4 + OTHERS)
FORD $180000
OTHER 8 PLANTS $20670
CANRON $14500
G.M $78000
HALEY $40000
TOTAL COST • $333,170

Based on the foregoing discussion, the total operating and capital cost for sampling activities are estimated to be $333,170 for the sector. The breakdown of total incremental sampling costs per plant is shown in Figure 2.1.

2.3 Flow Measurement

Flow measurement is required to allow accurate calculation of total loadings of contaminants discharged to the environment.

The operating cost estimates for flow measurement include manual calculation of flow, replacement of charts and calibration and maintenance of flow measurement devices. Operating cost estimates ranged from $0 to $10,000 (Ford) per plant. The total estimated operating cost to the 12 plants for flow measurement is $27,320.

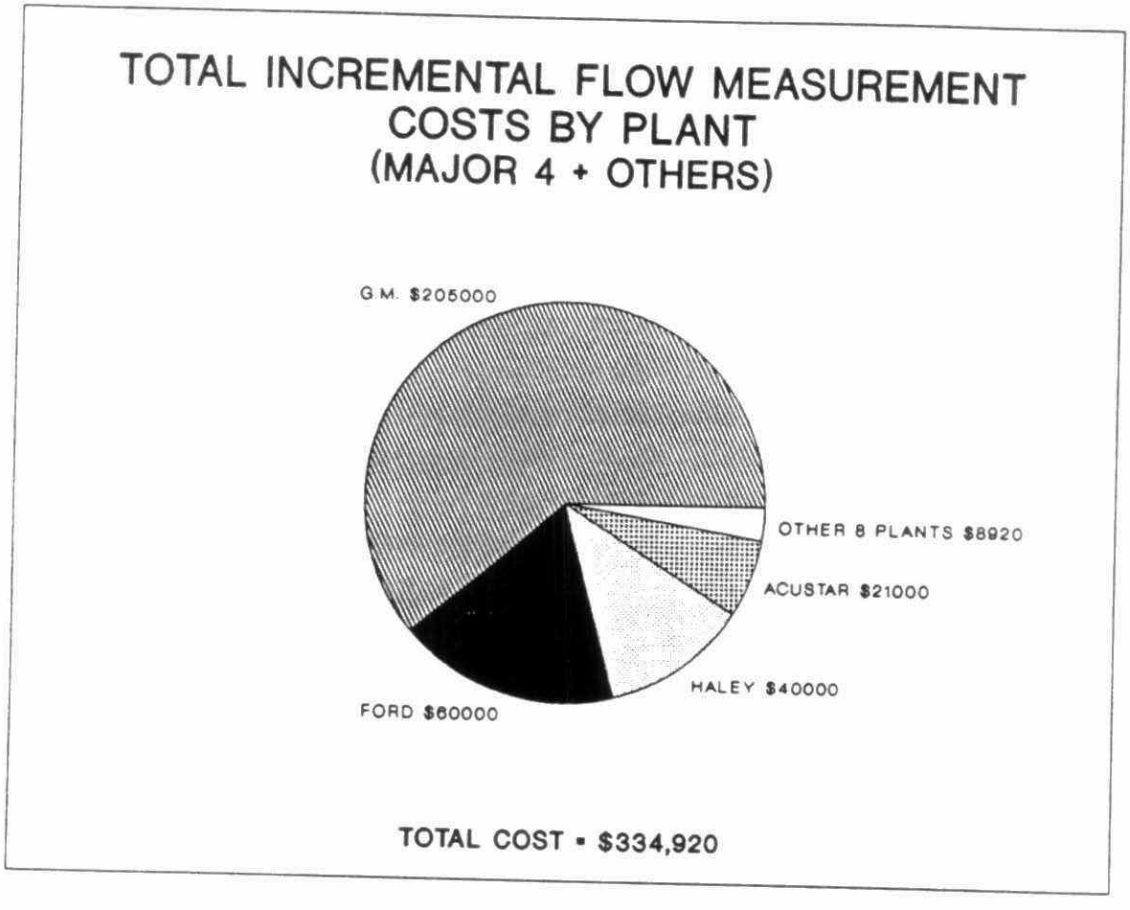
Primary and secondary flow measurement devices are required to achieve the accuracy specified for the process and final effluent sampling points.

Installation costs will vary among plants due to site-specific characteristics such as the volume of effluent flow, location of pipes, etc.

Capital costs of flow measurement facilities were supplied by each plant and reviewed by MOE technical staff. Capital costs for flow measurement equipment and installation range from $0 to $200,000 (General Motors) per plant. This large difference is due to the type and number of devices which the companies report they intend to install and the differences in costs for installation and preparatory site work. The total capital cost estimate for flow measurement for the 12 metal casting plants is $307,000, and is summarized in Table 2.4.

The total estimate for both capital and operating expenditures is $334,920. The distribution of total incremental flow measurement costs is illustrated below in Figure 2.2

FIGURE 2.2



2.4 Analytical Testing

As noted earlier, it is assumed that characterization, toxicity testing, and routine analyses will be performed by a commercial laboratory, even though some plants have the ability to conduct many of the analyses on-site. This has been done in order to obtain comparable cost estimates for each of the plants.

Analytical testing, includes characterization, routine and toxicity testing, which together represent the largest component of the incremental operating costs associated with monitoring, amounting to 73.5% of the total operating cost of monitoring for the sector.

The cost of analytical testing was estimated for the 12 month period of the regulations and is based on laboratory test prices listed in Table 2.3.

Because test prices can vary with volume discounts, average and low prices were used to calculate the costs of analytical testing. The 27 test groups include about 150 individual chemicals. In addition, open and elemental scans must be carried out on a certain set of samples. Some test groups, such as Groups 4a, 4b currently have one common price, even if only one compound within them requires testing. This feature may cause an overestimation in the cost of laboratory testing of samples.

Prices of laboratory tests include quality assurance/quality control (QA/QC) samples and the preparation of required reports from the lab to the plant, but do not include transport.

Some effluent streams are not continuous will be tested on an "event" basis.

The following cost estimates for "event" tested streams are based on the frequencies reported by the individual plants.

2.5 Routine Analyses

Routine analyses involve testing of samples for individual chemical compounds taken at four frequency levels - daily, three times per week, weekly, monthly, plus on an event basis.

TABLE 2.2

LABORATORY TEST PRICES FOR ANALYTICAL TEST GROUPS

No.	Analytical Test Group	Price ($)			
		Low	Median	Average	High
1.	Chemical Oxygen Demand	14.00	26.00	29.78	70.00
2.	Cyanide	10.00	32.50	36.10	100.00
3.	Hydrogen Ion (pH)	1.30	5.75	6.84	30.00
4a.	Ammonia and Ammonium Nitrogen plus Total Kjeldahl Nitrogen.				
4b.	Nitrate and Nitrite	40.00	55.60	86.99	230.00
5.	Organic Carbon (DOC)	10.00	50.00	57.03	130.00
6.	Total Phosphorus	8.75	20.00	25.12	120.00
7.	Conductivity	2.50	8.00	9.44	45.50
8.	Total Suspended Solids (TSS) Volatile Suspended Solids (VSS)	5.00	13.00	14.87	45.50
9.	Metals (13 metals)	10.00	-	84.10	491.40
10.	Hydrides (Arsenic only)	7.00	20.00	23.33	80.00
11.	Chromium (Hexavalent)	5.00	19.00	20.47	53.30
12.	Mercury	7.00	25.75	25.77	85.00
13.	Total Alkyl Lead	39.00	93.75	172.00	420.00
14.	Phenolics (4AAP)	19.50	35.00	42.93	130.00
15.	Sulphide	-	-	30.00	-
16.	Volatiles, Halogenated	83.00	226.25	239.90	1,020.50
17.	Volatiles, Non-Halogenated	85.00	200.00	176.81	435.50
18.	Volatiles, Water Soluble	50.00	195.00	126.50	325.00

TABLE 2.2 (Continued)

LABORATORY TEST PRICES FOR ANALYTICAL TEST GROUPS

No.	Analytical Test Group	Price ($)			
		Low	Median	Average	High
19	Extractables, Base Neutral	100.00	355.00	427.49	1,560.00
20.	Extractables, Acid (Phenolics)	65.00	260.00	245.68	780.00
21.	Extractables, Phenoxy Acid Herbicides	85.00	185.00	188.09	360.00
22.	Extractables, Organo-chlorine Pesticides	100.00	205.00	270.14	975.00
23.	Extractables, Neutral Chlorinated	105.00	200.00	232.04	900.00
24.	PCDDs & PCDFs	325.00	1,000.00	1,228.27	2,600.00
25.	Oil & Grease	15.00	30.00	36.00	125.00
26.	Fatty Acids & Resins	15.00	143.75	133.18	350.00
27.	PCBs (Total)	40.00	105.00	103.90	240.00
28. and 29.	Open Characterizations (Note 1)	-	-	850.00	-
	Supplemental Test Groups for the Metal Casting Sector				
	MC1: Metals	Included in Total Metals			
	MC2: Fluoride	-	-	26.50	-

NOTE 1: Average Open Characterization costs are calculated at $850 per test. This is calculated as $550 for ATG 28 (Volatiles and Extractables) plus $300 for ATG 29 (Elemental).

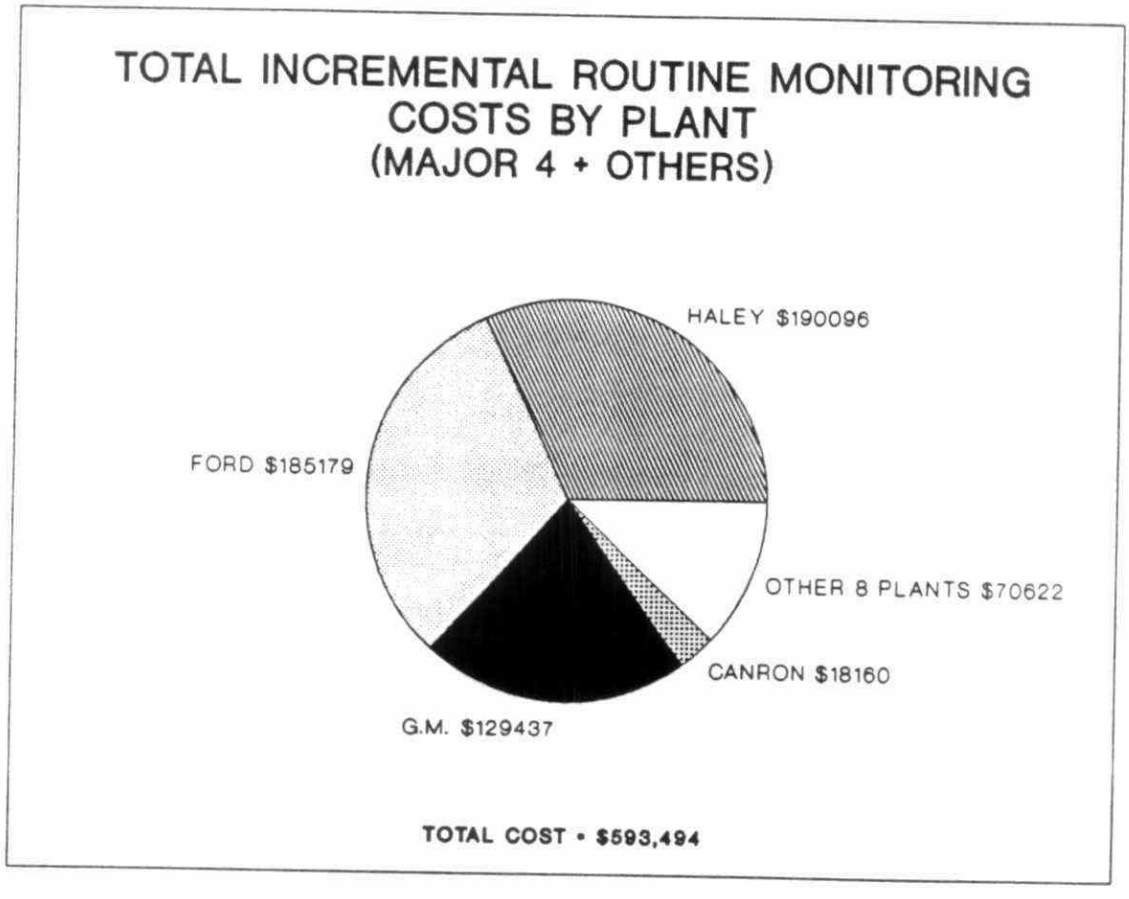
Source: Based on data derived from M.M. Dillon, Inventory and Critical Review of Laboratory Resources, Toronto. Prepared for the Ontario Ministry of the Environment, 1988.

Figure 2.3 below shows the cost of routine analyses per plant using average laboratory test prices.

The annual cost of routine analyses ranges from $4,724 for Franklin to $190,096 for Haley (See Table 2.4). However, Haley can reduce their routine analyses costs by half ($95,048) by combining their two effluent streams.

The total estimated annual cost of routine analyses under the average price scenario is $593,494. These estimates exclude transportation.

FIGURE 2.3



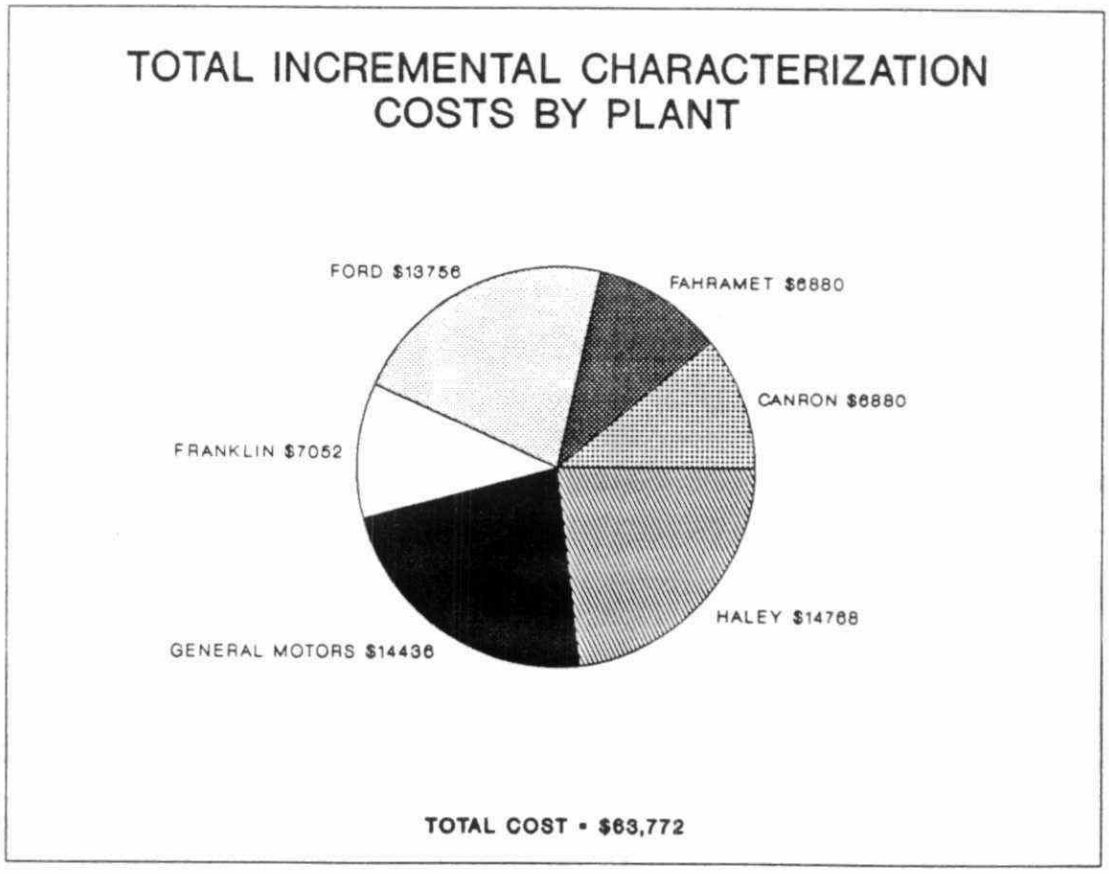
2.6 Characterization and Open Characterization Analyses

Characterization and open characterization analyses are procedures which identify the presence or absence of specified chemical species or analytical test groups in an effluent stream.

Figure 2.4 summarizes annual total characterization costs for the average price scenario, excluding transportation, per plant. Total characterization costs as shown in Table 2.4, ranged from $0 to $14,768 (Haley) per plant using average laboratory testing prices.

Total annual cost of characterization for the metal casting sector amounts to $63,772.

FIGURE 2.4



These cost estimates do not include pre-regulation characterization analyses. Pre-regulation monitoring is not specifically required by the Regulations, although this work was carried out in anticipation of the MISA monitoring activities.

2.7 Toxicity Testing

Biological toxicity testing involves the use of the static 96-hour rainbow trout toxicity test and a 48-hour Daphnia magna (a small invertebrate crustacean) mortality (acute lethality toxicity) test.

Process effluent and/or combined effluent will be tested monthly with trout toxicity and Daphnia Magna. Toxicity testing costs are based on the following prices for a full dilution series:

Trout: $360 per full dilution test
Daphnia: $240 per test

These prices do not include costs of collecting samples or transport to a laboratory.

Using these prices, the total annual cost for toxicity testing is $36,000 for the sector. The estimates per plant for each test are shown in Figure 2.5 below.

If three successive full dilution LC-50 rainbow trout tests prove non-toxic, subsequent rainbow trout tests may use the single concentration test on full strength effluent only. If any subsequent full strength test shows the stream to be toxic, full dilution LC 50 tests shall be required until the criterium is met. An effluent is defined as non-toxic if that effluent kills 20% or less of the rainbow trout at any dilution. Table 2.3 shows that under this scenario, toxicity costs could be reduced to $31,140.

FIGURE 2.5

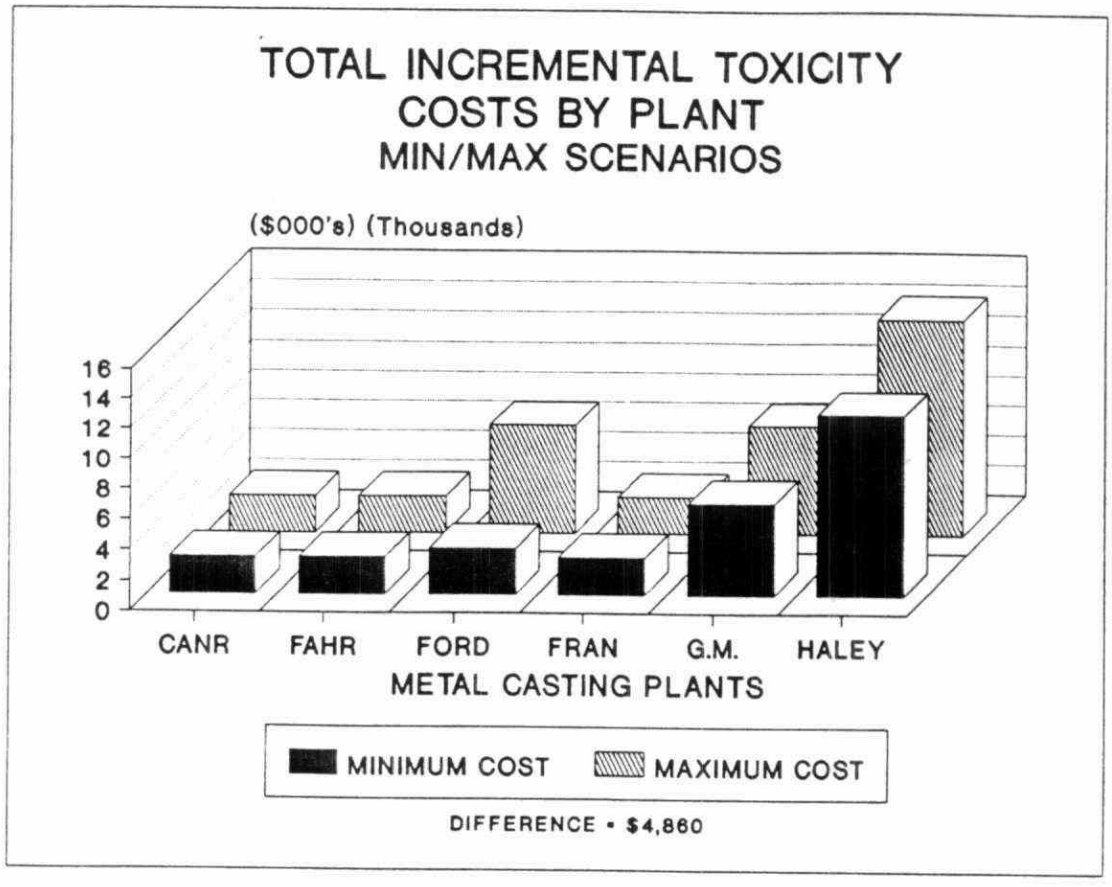

TOTAL INCREMENTAL TOXICITY
COSTS BY PLANT
MIN/MAX SCENARIOS
($000's) (Thousands)
16
14
12
10
8
6
4
2
0
CANR
FAHR
FORD
FRAN
G.M.
HALEY
METAL CASTING PLANTS
MINIMUM COST
MAXIMUM COST
DIFFERENCE • $4,860

TABLE 2.3

Metal Casting Direct Dischargers
Toxicity Testing Costs

Company/Plant	# of Sampling Points Requiring Toxicity Testing	# of Tests		Costs for Toxicity Testing				
				Trout		Daphnia	Total	
		Trout	Daph	Max	Min		Max	Min
Acustar Canada Inc-Etobicoke	0	0	0	$0	$0	$0	$0	$0
Bowmanville Foundry Co. Ltd.-Bowmanville	0	0	0	$0	$0	$0	$0	$0
Canron Inc.,Pipe Division-Hamilton	1	4	4	$1,440	$1,440	$960	$2,400	$2,400
Fahramet Steel Castings, Indusmin Division of Falconbridge Ltd.-Orillia	1	4	4	$1,440	$1,440	$960	$2,400	$2,400
Ford Motor Company of Canada Ltd.-Windsor	2	12	12	$4,320	$3,105	$2,880	$7,200	$5,985
Franklin Electric of Canada Ltd.-Strathroy	1	4	4	$1,440	$1,440	$960	$2,400	$2,400
General Motors of Canada Limited -St. Catharines	2	12	12	$4,320	$3,105	$2,880	$7,200	$5,985
Haley Industries Limited- Haley	2	24	24	$8,640	$6,210	$5,760	$14,400	$11,970
Magalloy Ltd.- Stratford	0	0	0	$0	$0	$0	$0	$0
Richmond Die Casting Ltd.-Cornwall	0	0	0	$0	$0	$0	$0	$0
A.H. Tallman Bronze Company Ltd. -Burlington	0	0	0	$0	$0	$0	$0	$0
Western Foundry Company Limited -Wingham	0	0	0	$0	$0	$0	$0	$0
Total	9	60	60	$21,600	$16,740	$14,400	$36,000	$31,140

Notes:

Cost per Test	
Trout:	$360
Pass/Fail	$225
Daphnia:	$240

Max - Assumes that three successive trout tests prove toxic, requiring continued use in remaining tests

Min - Assumes that three successive trout tests prove non-toxic, allowing for the use of the less expensive pass/fail testing for the remaining testing periods

2.8 Reporting

The reporting activity consists of two components: the initial report and "normal" daily/thrice weekly/weekly/monthly and quarterly reporting requirements.

Initial Report

A detailed "Initial Report" must be prepared and submitted to the Regional Director of the Ministry within three months and seven days following promulgation of the Regulation. This report is intended to provide the Ministry with a clear understanding of plant processes and the procedures each plant will follow in carrying out the requirements of this Regulation. The "Initial Report" details the plant layout, flow charts of waste streams, analytical methods used and other data. Cost estimates for preparing initial reports were submitted by each firm. As shown in Table 2.4, they range from $120 for the Fahramet plant to $20,000 for the Ford plant. The total estimated cost of the initial report preparation for the twelve casting plants is $28,310. It is likely that the actual costs to Ford might be lower because much of the information was collected for the pre-regulation monitoring.

Normal Report

Monitoring data will have to be assembled, recorded, stored, and reported to company management and to the Ministry of the Environment.

Data storage and manipulation may require an AT personal computer together with compatible peripherals and software, plus personnel dedicated to perform report generation functions.

Cost estimates for reporting, as supplied by individual plants, range from $240 up to $30,000, totalling $55,040 for the metal casting sector (See Table 2.4).

These wide differences are due to a number of reasons:

- the number of parameters to be tested varies greatly between plants,

- the number of sample points also varies between metal casting plants,

- some plants already have computers for data storage and manipulation.

The reported wage rates for data entry personnel range from $10 to $30/hr ranged per plant.

2.9 Analytical Testing of Intake Water

Another potential sampling point is intake water. The General and Metal Casting Monitoring Regulations do NOT specify monitoring requirements for intake water. However, plants which obtain water from large surface water sources which in turn receive the wastewater discharges of other municipalities and industrial plants have an incentive to sample their intake water. Data on intake water quality would permit the firms to determine how much of a contaminant is generated by the plant and how much was already contained in the wastewater.

General Motors and Richmond Die Casting Ltd. have included intake water monitoring in their sampling cost estimates. Therefore, the estimated cost of the Regulation requirements are actually overstated.

2.10 Total Estimated Costs of the MISA Metal Casting Sector Monitoring Requirements

The diversity of the plants, in size (A.H. Tallman, Burlington - 25 employees to General Motors, St. Catharines - 2,500 employees), water usage (A.H. Tallman - 25m^3/day to General Motors - 130,000m^3/day), and types of streams results in a wide range of incremental costs, since the monitoring requirements are of a site-specific nature.

Table 2.4 presents a summary of the estimates of operating and capital costs for each monitoring function at each plant. Total capital costs for the plants range from $100 to $238,000 (General Motors) for a total point estimate of $500,850. Based on prices for laboratory tests, reported in Table 2.2, total annual operating costs for the plants range from $7,675 (Magalloy) to $316,135 (Ford). The point estimate of the operating cost totals $943,856 for the 12 plants.

TABLE 2.4

TOTAL COSTS TO COMPANIES ASSOCIATED WITH MONITORING REGULATION

Monitoring Activities	Total	Acustar	Bowmanville	Canron	Fahramet	Ford	Franklin	G.M.	Haley	Magalloy	Richmond	A.H. Tallman	Western
Sampling:													
-Operating	$155,920	$3,000	$1,600	$12,700	$1,120	$60,000	$1,400	$40,000	$28,000	$1,400	$2,000	$2,800	$1,900
-Capital	$177,250	$1,000	$100	$1,800	$1,600	$120,000	$2,100	$38,000	$12,000	$100	$250	$200	$100
Total Sampling	$333,170	$4,000	$1,700	$14,500	$2,720	$180,000	$3,500	$78,000	$40,000	$1,500	$2,250	$3,000	$2,000
Flow Measurement													
-Operating	$27,320	$1,000	$300	$1,900	$0	$10,000	$150	$5,000	$8,000	$120	$250	$240	$360
-Capital	$307,600	$20,000	$0	$400	$5,000	$50,000	$200	$200,000	$32,000	$0	$0	$0	$0
Total Flow Measurement	$334,920	$21,000	$300	$2,300	$5,000	$60,000	$350	$205,000	$40,000	$120	$250	$240	$360
Initial Report													
-Operating	$28,310	$480	$800	$500	$120	$20,000	$200	$1,000	$4,000	$320	$125	$640	$125
-Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Initial Report	$28,310	$480	$800	$500	$120	$20,000	$200	$1,000	$4,000	$320	$125	$640	$125
Reporting													
-Operating	$39,040	$1,000	$300	$860	$400	$20,000	$450	$3,000	$12,000	$180	$250	$360	$240
-Capital	$16,000	$0	$0	$0	$0	$10,000	$0	$0	$6,000	$0	$0	$0	$0
Total Reporting	$55,040	$1,000	$300	$860	$400	$30,000	$450	$3,000	$18,000	$180	$250	$360	$240
Sub-Total	$751,440	$26,480	$3,100	$18,160	$8,240	$290,000	$4,500	$287,000	$102,000	$2,120	$2,875	$4,240	$2,725
Total Routine Monitoring	$593,494	$6,289	$5,655	$27,246	$5,557	$185,179	$4,724	$129,437	$190,096	$5,655	$10,916	$10,794	$11,946
Total Characterization	$45,072	$0	$0	$6,880	$6,880	$6,956	$7,052	$9,336	$7,968	$0	$0	$0	$0
Total Open Characterization	$18,700	$0	$0	$0	$0	$6,800	$0	$5,100	$6,800	$0	$0	$0	$0
Total Toxicity	$36,000	$0	$0	$2,400	$2,400	$7,200	$2,400	$7,200	$14,400	$0	$0	$0	$0
Total Cost to Plants For Monitoring Regulation	$1,444,706	$32,769	$8,755	$54,686	$23,077	$496,135	$18,676	$438,073	$321,264	$7,775	$13,791	$15,034	$14,671
Total Operating Costs	$943,856	$11,769	$8,655	$52,486	$16,477	$316,135	$16,376	$200,073	$271,264	$7,675	$13,541	$14,834	$14,571
Total Capital Costs	$500,850	$21,000	$100	$2,200	$6,600	$180,000	$2,300	$238,000	$50,000	$100	$250	$200	$100

The total estimated incremental cost of the MISA monitoring requirements per plant for the 12 metal casting plants ranges from $7,775 (Magalloy) to $496,135 (Ford). The total estimated costs to the twelve metal casting plants is $1,445,000.

Figure 2.6 below provides a breakdown of the total incremental costs by monitoring activity. The figure illustrates that the largest expense for the casting plants as a whole will be the routine analyses, estimated to be approximately $593,000. The flow measurement and sampling costs are the next two largest expenses accounting for approximately $335,000 and $333,000 respectively.

FIGURE 2.6

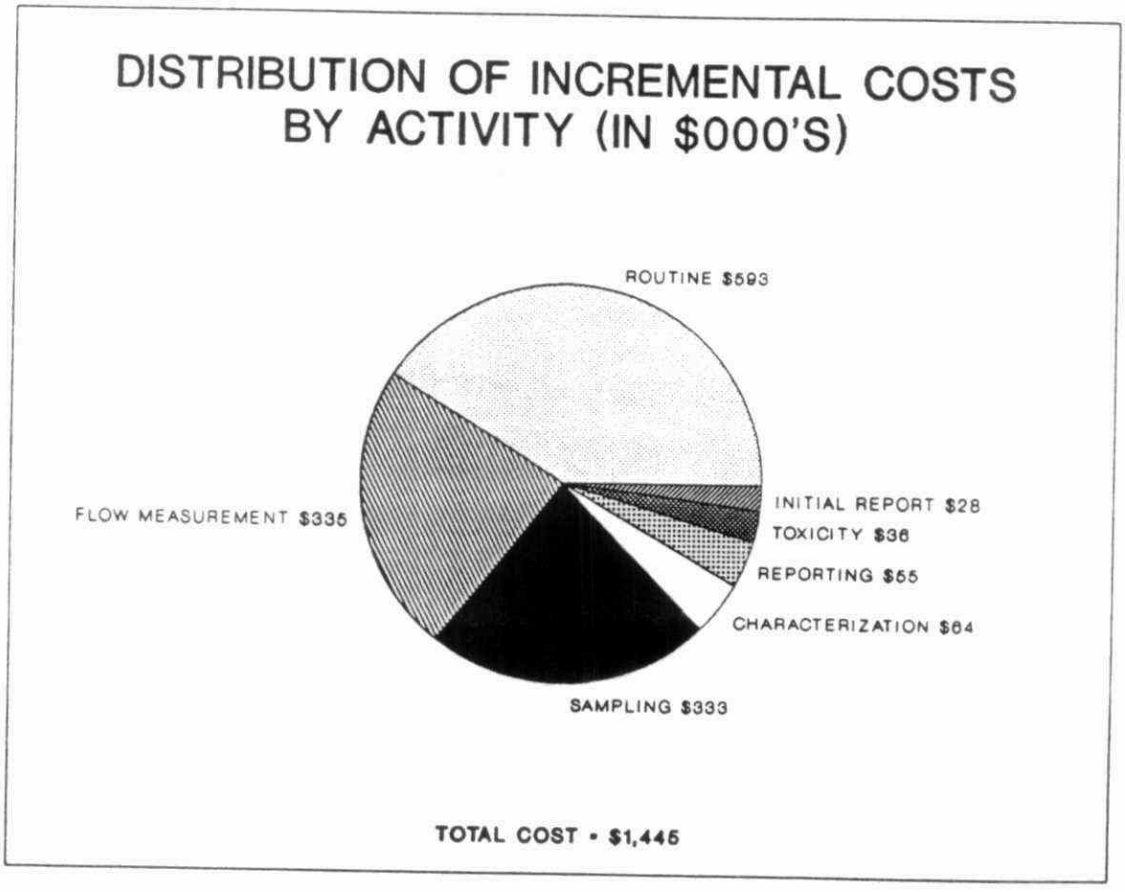
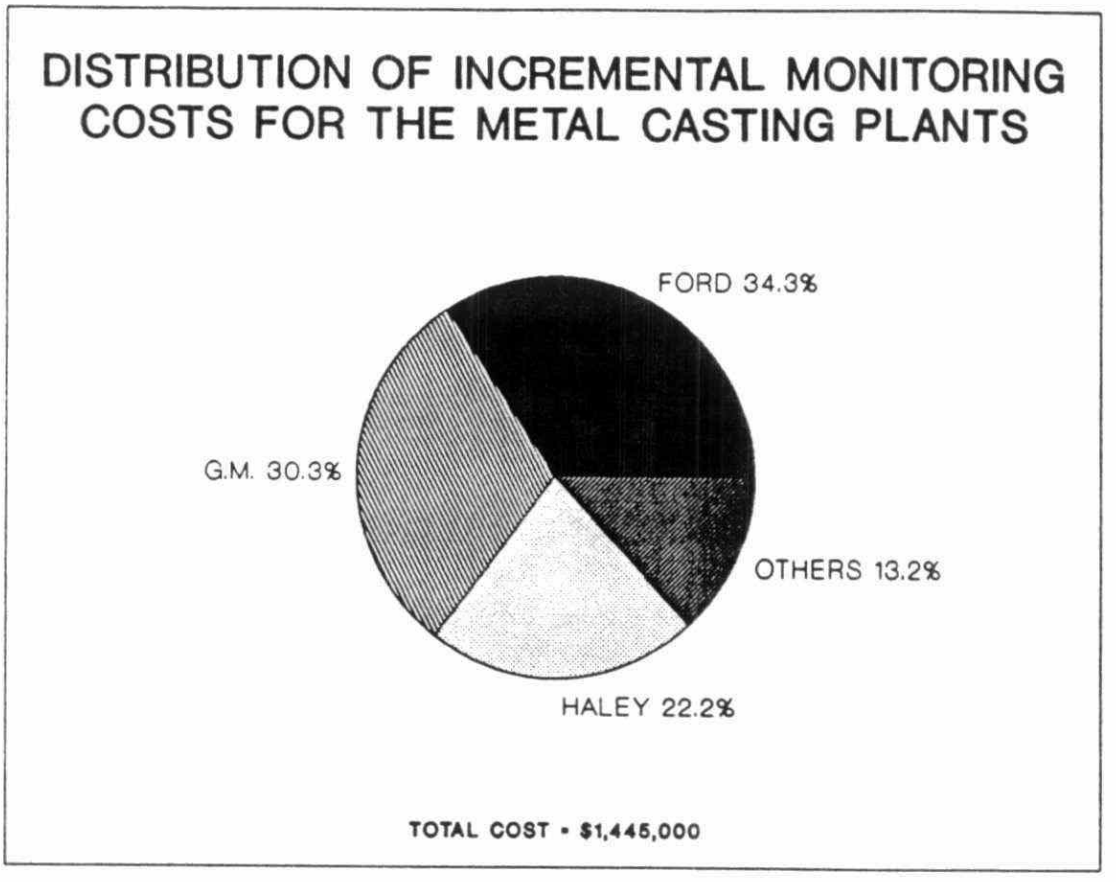


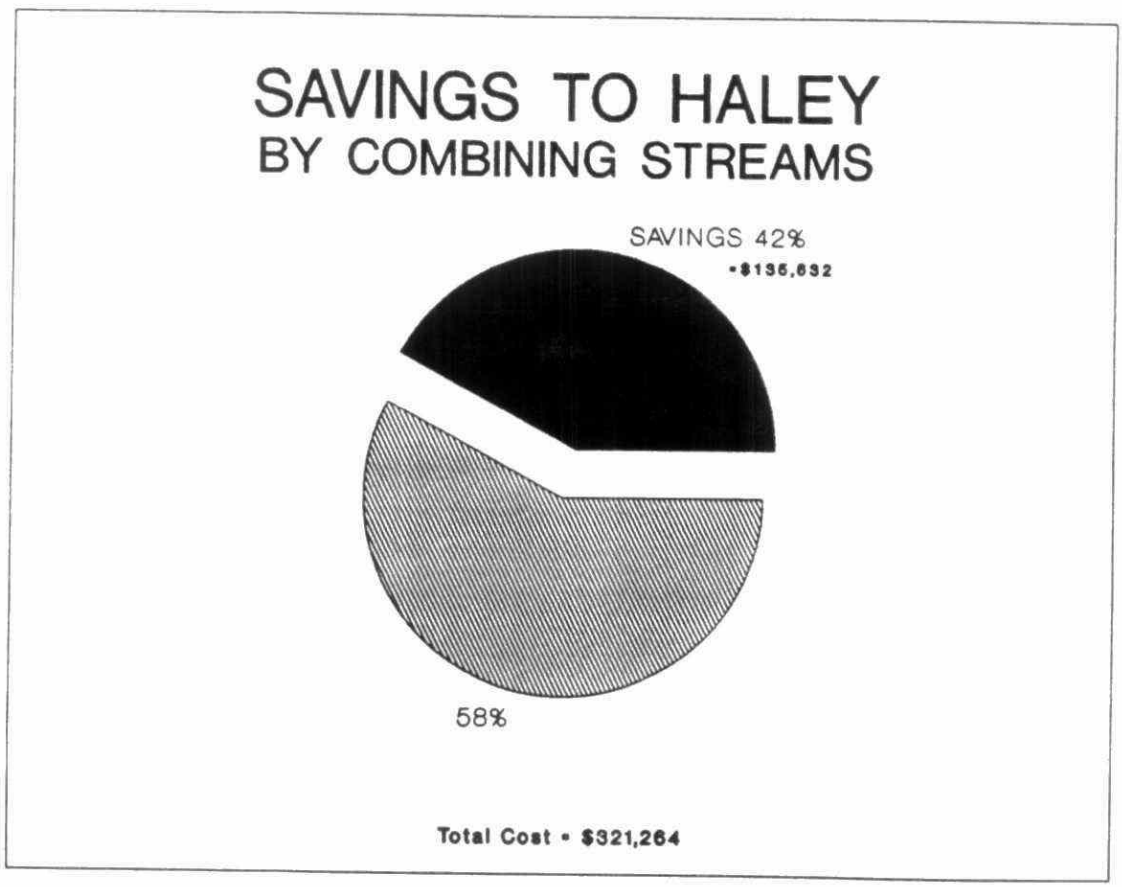
Figure 2.7 below shows the distribution of incremental monitoring costs for the metal casting plants. Three of the larger firms, (Ford, General Motors and Haley), will account for roughly 87% of potential expenditures. The remaining nine smaller operations account for the remaining 13% of estimated monitoring costs.

FIGURE 2.7



The cost estimates have been based on the current Regulation requirements and plant discharges. However, plants have identified opportunities to reduce their costs by modifications to their processes or discharge infrastructure. For example, Haley Industries Limited has notified the Ontario Ministry of the Environment that they plan to combine their two effluent streams so that they can reduce their number of sampling points to one. As shown in Figure 2.8, the savings to Haley by combining the two streams is estimated to be $135,632 or 42% of its estimated total cost of $321,264.

FIGURE 2.8



Magalloy has notified MOE of its intention to recirculate its cooling water, thereby eliminating its effluent stream. The estimated cost is approximately $6,000, which is lower than the $7,775 estimated cost of complying with the regulation.

Officials at A.H. Tallman have stated that they will convert from water cooling to air cooling (estimated cost of $5,500) and divert any remaining discharge to its sanitary sewer system. Although A.H. Tallman would not have comply with this Regulation, it will likely be subject to requirements under the future MISA Sewer Use Control Program.

It is likely that other companies will find further cost reductions as they evaluate their alternatives.

2.11 Alternative Estimates of Analytical and Toxicity Costs

The Metal Casting Sector Regulation specifies pipe-specific testing requirements. If, however, a pipe-specific approach was not adopted and plants were required to monitor all effluent streams for the same parameters at the same frequency, the cost of monitoring would increase.

The metal casting sector monitoring requirements were developed recognizing the fact that water usage, particularly for cooling purposes, differs significantly from most other sectors. Typical monitoring requirements used in other sector regulations for cooling water, i.e. quarterly toxicity testing and characterization, were not considered necessary. If these typical monitoring requirements were applied, the cost burdens would differ.

An alternative set of analytical and toxicity costs were estimated for an "equitable" scenario, in which all plants are subject to the same generic testing schedules. This was done in order to illustrate the cost effectiveness of having pipe-specific requirements. The following assumptions were used to generate this "equitable" scenario.

1. Same parameters were tested at same frequency.

2. Cooling water effluent streams containing small quantities of process effluent would be subjected to process effluent stream monitoring requirements.

3. Cooling water effluent streams would be subjected to quarterly characterization and toxicity testing.

4. The estimates are based on average laboratory prices as shown in Table 3.

The implications of this scenario for other monitoring functions, such as sampling, flow measurement and reporting were not calculated because the largest differences would occur in the analytical and toxicity analyses which are listed below.

The "equitable" scenario resulted in analytical and toxicity costs ranging from $14,840 to $219,344 per plant. This scenario also resulted in a total

estimated analytical and toxicity cost of $1,155,848 for the direct dischargers in the metal casting sector. The estimated costs for the "equitable" scenario would represent a 66.7% increase over the $693,266 total cost of the proposed regulation for these activities.

Table 2.5 and Figure 2.9 below illustrate that the pipe-specific requirements under the proposed regulation is estimated to cost $460,000 less than the "equitable" scenario. Much of the additional cost burden would be borne by mid-size and smaller plants. For example, the cost of the monitoring activities for Canron would increase $123,000 from $37,000 to $160,000. The costs to Franklin and Fahramet would increase over $94,000 each.

The cost difference between the two scenarios is a measure of the cost-effectiveness of the pipe-specific approach proposed for the metal casting sector. The MOE has been cognizant of the potential financial implications of the MISA requirements, and has incorporated such considerations in the development of the monitoring regulations.

FIGURE 2.9

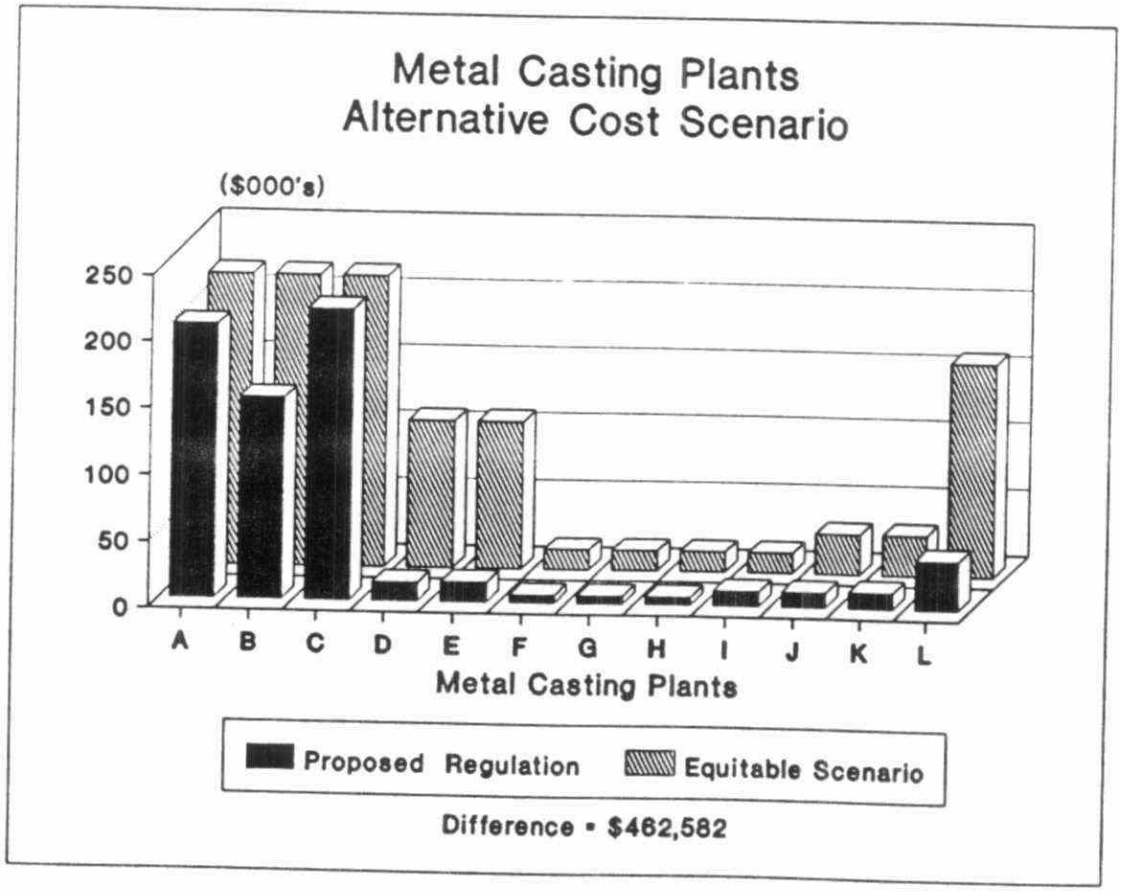


TABLE 2.5

COMPARISON OF ALTERNATIVE ANALYTICAL AND TOXICITY TESTING COST SCENARIOS

	COMPANY	COSTS			DIFFERENCE
		PROPOSED REGULATION	"EQUITABLE SCENARIO"		
A-	FORD	$206,135	$219,344	(109,672 X 2)	$13,209
B-	G.M.	$151,073	$219,344	(109,672 X 2)	$68,271
C-	HALEY	$219,264	$219,344	(109,672 X 2)	$80
D-	FRANKLIN	$14,176	$109,672		$95,496
E-	FAHRAMET	$14,837	$109,672		$94,835
F-	ACUSTAR	$6,289	$14,840		$8,551
G-	BOWMANVILLE	$5,655	$14,840		$9,185
H-	MAGALLOY	$5,655	$14,840		$9,185
I-	RICHMOND	$10,916	$14,840		$3,924
J-	TALLMAN	$10,794	$29,680	(14,840 X 2)	$18,886
K-	WESTERN	$11,946	$29,680	(14,840 X 2)	$17,734
L-	CANRON	$36,526	$159,752	(109,672 + (3)(14,840) + 5,560)	$123,226
		$693,266	$1,155,848		$462,582

UNIT PRICE PER STREAM

PROCESS= $95,592 (ROUTINE) + $3,480 (CHARACTERIZATION) + $3,400 (OPEN) + $7,200 (TOXICITY) = $109,672

COOLING WATER= $5,560 (ROUTINE) + $3,480 (CHARACTERIZATION) + $3,400 (OPEN) + 2400 (TOXICITY) = $14,840

STORM WATER=$5,560 (ROUTINE)

3.0 ECONOMIC EFFECTS AND IMPLICATIONS OF MONITORING COSTS

3.1 Industry Performance

Although the Ontario and Canadian economies have displayed strong growth in GDP since the early 1980s recession, the metal casting industry has not experienced similar growth (Deloittes, Haskins and Sells, 1988). Demand for castings has stablized after years of decline which resulted from a greater availability of substitute materials, a decrease in size and weight of major durable goods, the advance of alternative production technologies and the demise of traditional industries that required a large amount of casted parts. The metal casting industry also experiences strong competition and is characterized by easy exit and entry.

The demand for castings is primarily driven by the demand for durable goods. Current economic trends in Canada and Ontario indicate a growing economy and a strong demand for durable goods for consumption and investment. Moderate growth is expected for the Canadian economy over the next three years, with stable demand for durable goods and therefore castings (Deloitte Haskins and Sells, 1988). A recession, which appears unlikely at this time, could drastically reduce the demand for durable goods and the demand for castings.

The limited financial information available for metal casting manufacturers indicates that companies have recovered from the large losses earlier in the decade and are beginning to earn a reasonable rate of return on capital. Profitability does, however, vary widely in the industry, with some companies still experiencing losses and insolvency and other companies earning substantial net incomes (Deloitte, Haskins and Sells, 1988).

Few financial statements were available for the twelve direct discharging metal casting firms, because five of these plants belonged to private corporations, which do not publish financial statements. Another six of these plants are divisions or subsidiaries of public corporations. Nevertheless, financial information was collected for eight of the twelve firms.

Ideally, we would want to evaluate the implications of the extra monitoring costs on the specific plants which have to incur them. However, only publicly owned companies publish their financial data. Invariably, such data are a consolidation of all of a firm's plants and operations. In rare instances a public company operates a single plant, so that financial data characterize that particular facility. However, where plant-specific data are not available, analyses using consolidated company data provide useful insights about the impacts of the proposed costs.

The information was assembled from Deloitte, Haskins and Sells (1988), company published financial statements, and other references. Relevant performance information can be found in Appendices F-I. These data are not complete but they show that following reduced earnings or losses for many of the firms in 1982 and 1983, performance has generally improved. After-tax profits have generally increased over the period for the eight casting plants, although Falconbridge (Fahramet) showed an average after-tax net loss for the period. However, Falconbridge (Fahramet) had a profit in 1987 and record earnings estimated at $341 million for 1988.

3.2 Analytical Procedures

Monitoring costs incurred by the firms under the MISA regulations will increase operating expenses and, unless there is some offsetting increase in productivity associated with wastestream monitoring, profits to the firms and returns on particular plants will be reduced. In this section, economic effects of these costs on the industry and on those firms for which financial data are available will be examined.

The approach taken in this analysis will be to estimate how the appropriate incremental monitoring costs would affect historic after-tax profits, capital expenditures and the return on capital employed by each firm. The analysis will show how the monitoring costs would have changed each firm's performance measures if they had been incurred during the worst year over the past 4 to 6 years and how they might have affected the average financial performance over the past 4 to 6 years for which relevant data are available. These analyses reveal the extent to which monitoring

costs would reduce a company's performance measures below its own historical averages. Morever, comparisons can be made with these same performance measures for the industry as a whole where these are available.

Where long term investment decisions are concerned, a key economic variable is the rate of return on investment or capital employed. This is the return that provides the incentive for owners and investors to remain in a particular enterprise or move on to something else. In this study, the Statistics Canada definition was used in which the ratio is equal to:

$$\frac{\text{After-tax Profits + Interest Payments + Extra-ordinary Expenses}}{\text{Total Assets - Current Liabilities}}$$

Consequently, the first analysis will show how the potentially recurring operating costs of monitoring would have affected the rate of return on capital employed for individual firms for which data is available.

For this analysis, operating costs of monitoring were first reduced by the amount of the appropriate corporate tax rate because part of these costs are offset by reduced income taxes. The adjusted incremental operating cost of monitoring was then subtracted from after-tax profits to determine a new rate of return on capital employed. This calculation was carried out for each firm in each year for which data were available. The new rates of return could then be compared with average rates of return for the industry as well as each firm's historical performance records.

Another analytical approach involves calculating the ratio of operating costs of monitoring to after-tax profits. This ratio indicates the proportion of after-tax profits, assuming the firm was unable to pass on any of the monitoring costs as increased prices, that would have to be diverted to monitoring activities. This calculation yields an over-estimate of the effect because operating costs of monitoring are not reduced by the corporate tax rates as was done in the previous analysis.

A third analytical procedure was carried out to determine the extent to which capital requirements for monitoring would divert capital expenditure

away from other uses. Estimated capital costs of monitoring were thus computed as a percent of total capital expenditures for each firm in each year for which capital expenditure data are available. There is no rule of thumb as to what proportion of capital expenditures should be devoted to environmental protection in any given year. Some industrial representatives assert that a minimum capital expenditure is necessary to carry out a sufficient amount of repair and replacement in order to keep a plant running. These basic expenditures apparently vary from industry to industry and from firm to firm.

This comparison of expected capital expenditures to actual outlays is conservative in that it overstates the potential diversion of funds in a given year. Environmental capital expenditures can be fully deducted against income over a three year period at the rate of 25%, 50%, and 25%. Therefore, the reduction to income in a single year would be less than the full amount of capital expenditures that is used in this analysis.

International competitiveness can be affected by environmental expenditures to the extent that firms may be unable to maintain product quality or pass along cost increases in the face of international market-determined competitive prices for specific products.

These analyses are by no means definitive but they can identify those firms which could experience financial effects that are large relative to (a) their own historical performance, (b) other firms' performance in the same industry, and/or (c) industry performance.

Financial data are seldom available for individual plants although it is at this level where financial consequences can often influence decisions or affect the viability of an operation. Assessments and comparisons will generally have to be made against consolidated company data which are publicly available. For some firms, a limited amount of disaggregated data on the metal casting segments of their businesses is published. These data will be used in the analyses rather than consolidated company data where they are available.

Furthermore, as noted, while it would be ideal to assess the consequences of increased costs on individual plants, assessments at the level of the firm are better than no information at all.

Finally, where a company believes that it will suffer undue financial burdens by complying with environmental requirements, it may request a detailed financial analysis under provisions of the Ministry's Policy and Procedures Manual (Policy 02-01). Plant-specific data used in these analyses would remain confidential under the provisions of The Ontario Freedom of Information Act.

3.3 Economic and Financial Implications

Financial information on eight of the twelve metal casting firms can be found in Appendices F-I. Where financial information was not available at the plant level the next reporting level was used. For Acustar Canada Inc. financial information was obtained from Chrysler U.S. Financial information for Falconbridge Ltd. was used for Fahramet Steel Castings Indusmin Division. Franklin Electric Company Inc. financial information was used for its subsidiary, Franklin Electric of Canada Ltd.

Table 3.1 below presents a summary of the percentage reduction in the rate of return on investment that would be imposed for the eight metal casting plants for which data are currently available. On average, operating costs of monitoring would reduce company rates of return by up to 0.78%. The largest percentage reduction, 0.78% for Haley Industries Ltd., can be reduced to 0.39% if Haley combines its two effluent streams.

Table 3.2 presents a summary of the effects of expected monitoring costs on after-tax profits (net earnings) and capital expenditures for eight of the twelve metal casting firms.

As indicated, percentages are computed for the highest, lowest and average net earnings and capital expenditures for the period 1981 to 1987.

During this period Falconbridge Ltd., experienced on the average after-tax losses. However, as stated earlier in this report, Falconbridge has achieved record profits estimated at approximately $341 million in 1988.

TABLE 3.1

PERCENTAGE REDUCTION ON AVERAGE RETURN ON CAPITAL EMPLOYED DUE TO INCREMENTAL OPERATING COST

FIRM	PERCENTAGE REDUCTION (shown in negative)
Bowmanville	-0.50%
Canron Inc.	-0.02%
Chrysler U.S. (1)	<01%
Falconbridge (2)	<01%
Franklin U.S. (3)	-0.01%
Ford	-0.02%
General Motors	-0.01%
Haley	
- (assuming 2 sample points)	-0.78%
- (assuming combined streams)	-0.39%

Source: Company Annual Financial Statement

(1) Consolidated Chrysler U.S. financial data were used for Acustar Canada Inc.

(2) Consolidated Falconbridge financial data were used for Fahramet Steel Castings Indusmin Division.

(3) Consolidated Franklin U.S. financial data were used for Franklin Electric of Canada Ltd.

Figure 3.1 below illustrates the impact of: estimated capital cost for monitoring as a percentage of average annual capital expenditure per plant; and estimated annual monitoring cost as a percentage of average after-tax profit per plant.

FIGURE 3.1

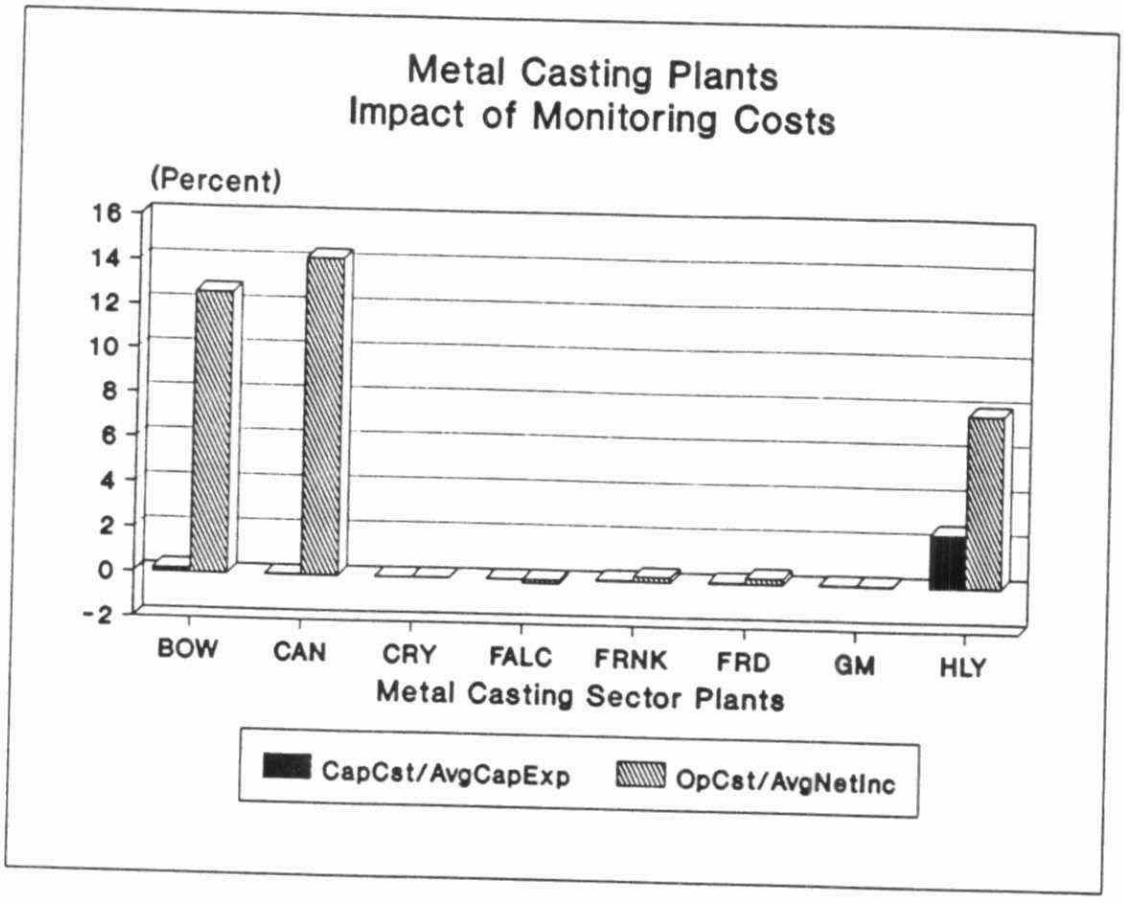


TABLE 3.2

SUMMARY

IMPACT OF MONITORING COSTS
ON SELECTED FINANCIAL INDICATORS
(1982-1987)

PLANT	CAPITAL EXPENDITURES			AFTER-TAX EARNINGS		
	Monitoring Capital Cost as a % of Annual Average Capital Expenditure			Monitoring Operating Cost as a % of Annual Average After-Tax Earnings (Loss)		
	Highest Year	Lowest Year	Average	Highest Year	Lowest Year	Average
BOWMANVILLE	0.075%	10.0%	0.2%	5.404%	(15.263)%	12.609%
CANRON	0.01%	0.04%	0.018%	0.348%	(0.155)%	14.189%
CHRYSLER (Acustar)	0.005%	0.001%	0.001%	0.000%	0.006%	0.001%
FALCONBRIDGE (Fahramet)	0.006%	0.038%	0.013%	0.043%	(0.019)%	(0.159)%
FRANKLIN U.S. (Franklin Canada)	0.079%	0.036%	0.046%	0.168%	0.289%	0.224%
FORD	0.042%	0.078%	0.062%	0.106%	(0.293)%	0.258%
GENERAL MOTORS	0.018%	0.089%	0.041%	0.023%	(0.229)%	0.038%
HALEY	1.178%	5.701%	2.385%	4.211%	(13.464)%	7.699%

Source: Company Annual Financial Statements

Capital costs, when viewed in terms of average annual capital expenditures over the 1982 to 1987 period, represent between 0.001% (for Acustar owned by Chrysler U.S.) to 2.385% (for Haley) of such expenditures. These costs appear to be fiscally manageable for these firms.

Figure 3.1 and Table 3.2 indicate that monitoring operating costs in relation to average annual-after tax profits over the 1982 to 1987 period, range from approximately 0% for Chrysler (Acustar) to 14% for CANRON Inc. The bar graphs in Figure 10 highlight potential impacts of monitoring operating costs on three of the eight firms: Bowmanville, Canron, and Haley.

The monitoring operating cost as a percentage of annual average after-tax earnings for Bowmanville Foundry Company is estimated at 12.6%. Bowmanville is a private company and under new ownership, however financial information is available from 1983 to 1986. The company's record of profitability was not impressive. After-tax profit in 1984 was quite high ($161,600), with an 18% return on capital, but profits declined for the subsequent two years. However, the company had a solid financial base. It had no debt and extremely high current and quick ratios in each year from 1983 to 1986. Therefore, there is no reason to believe that Bowmanville would find the estimated total cost of $8,800 for the Regulation fiscally unmanageable.

The largest impact of 14.2%, for monitoring operating cost as a percent of annual after-tax earnings, occurs at Canron. The company has maintained a fairly stable financial position over the years 1982 to 1986. The working capital ratio has averaged 2.5:1 and the debt to equity ratio has been constant at 1:2. Profitability has steadily increased between 1982 and 1986. The company reported a major loss of approximately $34 million in 1982, partly a result of a reorganization to shed losing divisions. When this year, which is clearly an anomaly, is removed from the analysis, the impact of operating costs on average annual after-tax earnings is reduced to a much less significant 5.8%.

Haley Industries Ltd. faces an estimated impact of 7.7% for operating costs relative to average annual after-tax earnings. If Haley combines their two effluent streams as indicated, the impact will be reduced to 3.9%.

Of the four remaining firms for which financial information is available, two companies, Magalloy and A.H. Tallman have stated their intention to eliminate their direct discharges. The remaining two firms, Richmond Die Casting and Western Foundry, face approximately $14,000 and $15,000 respectively.

Therefore, the impacts of the incremental costs are varied for individual firms but appear to be fiscally manageable. Nevertheless, additional financial data may be made available by the plants or firms to evaluate financial impacts in more detail.

Two further qualifications regarding the proposed monitoring costs on the metal casting plants are noted.

First, the monitoring costs cited in this report constitute only a part of the environmental protection costs this, and other, industrial sectors will face in Ontario, and elsewhere for that matter. Some of the firms in the metal casting industry operate plants in other industrial sectors which are subject to MISA monitoring regulations. IVACO and Falconbridge are examples of this.

Furthermore, direct discharger firms may face additional costs of further abatement of water, air and solid waste pollutants as new requirements are put in place. Under MISA, effluent limits regulations will be promulgated and regulations concerning air pollution control are being amended which could imply further costs (Ontario Ministry of the Environment, November 1987).

These cumulative costs burdens may be further increased by regulatory requirements for workplace health and safety and for consumer protection which are administered by other provincial and federal government agencies.

A second qualification has the potential to offset the cost burden to an industry or an individual firm. Depending on market structure of the industry and demand conditions facing Ontario firms, companies will be able to pass on some or all incremental costs in the form of higher prices.

Vertically integrated operations, such as Ford and General Motors, are more likely to be able to divert some of their costs by increasing their prices.

The ability to pass on costs also depends on the range of regulatory costs which befall each plant or firm.

Although the emphasis of this report has been on the cost of monitoring, there are benefits that should be noted.

Potential benefits to the metal casting plants required to monitor include reduction to operating costs by reducing water usage and process material losses, and goodwill gained by demonstrating to the public that the company is a good corporate citizen responding to environmental problems.

The monitoring requirements may induce a small, but positive impact on employment because extra staff may be required to take samples, maintain equipment and report data. Temporary increases in construction activity are expected at some of the plants. Furthermore, demand for laboratory services as well as flow measurement and sampling equipment from these plants will increase during the period of the monitoring regulation. The monitoring data base will be available to design cost-effective control programs aimed at the virtual elimination of toxic contaminants at their source.

Lastly, the benefits of reducing pollution include enhanced recreation activities, better drinking water, improved aesthetics and the knowledge that our society has taken a step towards preserving our water for generations to come.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Conclusions reached in this review are as follows:

(a) Incremental capital costs for the 12 metal casting plants are estimated at $501,000, and range on a per plant basis from $100 to $238,000.

(b) Operating cost estimates over the 12 month period range from $7,700 to $316,000 per plant, and total approximately $944,000.

(c) The total point estimate of the incremental costs for complying with the regulation is estimated at approximately $1,445,000.

(d) The diversity of the plants in metal casting sector results in a wide range of incremental costs. The three largest plants will account for roughly 87% of total estimated expenditures. The remaining nine smaller operations will account for the remaining 13% of potential expenditures.

(e) Plants have identified opportunities to reduce their costs through modifications to their processes or discharge infrastructure. The estimated savings to one plant alone, by combining its effluent streams so that they can reduce their number of sampling points to one, is $136,000.

(f) Financial impacts on the individual metal casting plants subject to MISA monitoring requirements are varied, but all appear to be fiscally manageable.

(g) Capital costs, when viewed in terms of average annual capital expenditures over the 1982 to 1987 period, represent up to 2.4% of such expenditures.

(h) Operating costs of monitoring would have reduced annual average after-tax profits by .001 to 14%.

(i) Potential benefits to the metal casting plants required to monitor include reduction to operating costs by reducing water usage and process material losses, and goodwill gained

by demonstrating to the public that the company is a good corporate citizen responding to environmental problems.

(j) The monitoring requirements may induce a small, but positive impact on employment because extra staff may be required to take samples, maintain equipment and report data. Temporary increases in construction activity are expected at some of the plants.

Furthermore, demand for laboratory services as well as flow measurement and sampling equipment from these plants will increase during the period of the monitoring regulation. The monitoring data base will be available to design cost-effective control programs aimed at virtual elimination of toxic contaminants at their source.

4.2 Recommendations

In order to identify possible problems at an early stage, it is recommended that the Ministry of the Environment and the industry work together to identify the actual incremental capital and operating costs of the monitoring requirements in the early portion of the regulation period. Early identification of possible financial burdens will enable this Ministry and the individual plant to review and devise workable solutions.

Also, at the end of the regulation period, it is recommended that each plant report the actual incremental costs incurred due to the MISA monitoring requirements in order to:

- validate and improve the cost-estimation procedures used in this report.

- monitor and assess the financial and employment impacts of the monitoring requirements.

The cumulative financial burdens of monitoring requirements in other sectors, other MISA requirements, air and solid waste control regulations and regulatory requirements by other federal and provincial agencies should be monitored.

Finally, when monitoring data and activities at these plants (and other industrial dischargers) are audited by Ministry of the Environment personnel or their agents, information should be gathered to determine whether the monitoring activities or data have been, or could be, helpful in making the operations or processes more efficient and productive.

APPENDICES

A - I

APPENDIX A

TABLE A-1

SUMMARY ESTIMATES
OF THE INCREMENTAL COSTS BY PLANT
FOR THE 12 METAL CASTING PLANTS

Plant	Location	1988 $ in thousands (rounded) Operating	Capital	TOTAL
Acustar	Etobicoke	11.8	21.0	32.8
Bowmanville	Bowmanville	8.7	0.1	8.8
Canron	Hamilton	52.5	2.2	54.7
Fahramet	Orillia	16.5	6.6	23.1
Ford	Windsor	316.1	180.0	496.1
Franklin	Strathroy	16.4	2.3	18.7
G.M.	St. Catherines	200.1	238.0	438.1
Haley	Haley Station	271.3	50.0	321.3
Magalloy	Stratford	7.7	0.1	7.8
Richmond	Cornwall	13.6	0.2	13.8
A.H. Tallman	Burlington	14.8	0.2	15.0
Western	Wingham	14.6	0.2	14.8
		944.1	500.9	1445.0

APPENDIX B(TABLE B-1)

TOTAL COSTS TO COMPANIES ASSOCIATED WITH MONITORING REGULATION(INCLUDES MEETINGS AND PRE-REGULATION)

Monitoring Activities	Acustar	Bowmanville	Canron	Fahramet	Ford	Franklin	G.M.	Haley	Magalloy	Richmond	A.H. Tallman	Western
Sampling:												
-Operating	$3,000	$1,600	$12,700	$1,120	$60,000	$1,400	$40,000	$28,000	$1,400	$2,000	$2,800	$1,900
-Capital	$1,000	$100	$1,800	$1,600	$120,000	$2,100	$38,000	$12,000	$100	$250	$200	$100
Total Sampling	$4,000	$1,700	$14,500	$2,720	$180,000	$3,500	$78,000	$40,000	$1,500	$2,250	$3,000	$2,000
Flow Measurement												
-Operating	$1,000	$300	$1,900	$0	$10,000	$150	$5,000	$8,000	$120	$250	$240	$360
-Capital	$20,000	$0	$400	$5,000	$50,000	$200	$200,000	$32,000	$0	$0	$0	$0
Total Flow Measurement	$21,000	$300	$2,300	$5,000	$60,000	$350	$205,000	$40,000	$120	$250	$240	$360
Initial Report												
-Operating	$480	$800	$500	$120	$20,000	$200	$1,000	$4,000	$320	$125	$640	$125
-Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Initial Report	$480	$800	$500	$120	$20,000	$200	$1,000	$4,000	$320	$125	$640	$125
Reporting												
-Operating	$1,000	$300	$860	$400	$20,000	$450	$3,000	$12,000	$180	$250	$360	$240
-Capital	$0	$0	$0	$0	$10,000	$0	$0	$6,000	$0	$0	$0	$0
Total Reporting	$1,000	$300	$860	$400	$30,000	$450	$3,000	$18,000	$180	$250	$360	$240
Sub-Total	$26,480	$3,100	$18,160	$8,240	$290,000	$4,500	$287,000	$102,000	$2,120	$2,875	$4,240	$2,725
Total Routine Monitoring	$6,289	$5,655	$27,246	$5,557	$185,179	$4,724	$129,437	$190,096	$5,655	$10,916	$10,794	$11,946
Total Characterization	$0	$0	$6,880	$6,880	$6,956	$7,052	$9,336	$7,968	$0	$0	$0	$0
Total Open Characterization	$0	$0	$0	$0	$6,800	$0	$5,100	$6,800	$0	$0	$0	$0
Total Toxicity	$0	$0	$2,400	$2,400	$7,200	$2,400	$7,200	$14,400	$0	$0	$0	$0
Total Cost to Plants For Monitoring Regulation	$32,769	$8,755	$54,686	$23,077	$496,135	$18,676	$438,073	$321,264	$7,775	$13,791	$15,034	$14,671
Pre-Regulation Characterization and Meeting/Consultation	$15,000	$1,800	$1,250	$3,000	$56,000	$500	$35,000	$25,000	$500	$500	$500	$4,150
Total Costs to Plants	$47,769	$10,555	$55,936	$26,077	$552,135	$19,176	$473,073	$346,264	$8,275	$14,291	$15,534	$18,821

APPENDIX C
FACTORS AND ASSUMPTIONS CONSIDERED

Transportation:

Transportation cost to labs estimated by MOE for those companies that did not submit estimates. Transportation cost per sampling point estimated at approximately $1000. (See Appendix D).

Refrigeration:

MOE assumed that all companies required to do toxicity tests should factor into their estimate the cost of a refrigerator. MOE estimated the cost to be approximately $1500 and used this estimate for those companies that did not factor this into their cost estimates.

MOE assumed that those companies not required to do toxicity testing or any characterization testing would ship their samples during the same day and and therefore would not require refrigerators.

Haley:

Company operating cost estimates assumed combining two streams and therefore reducing the number of sampling points from two to one. Therefore, MOE estimate doubled operating costs to reflect current requirements for two sampling points.

Cost of capital is over-estimated since it includes cost of combining to streams.

If Haley combines the two streams, operating, analytical and toxicity cost estimates are expected to be reduced by half, resulting in total cost savings of ($321,264 - $185,632) $135,632. (See Appendix E).

Richmond:

The company has assumed two sampling points in their estimate, since they have chosen to monitor intake as well as discharge. Therefore, analytical and toxicity test cost estimates made by MOE have been doubled to $10916.

If the company chose not to monitor intake water, the savings in operating and analytical costs are estimated to be approximately $7270.

Magalloy:

Pre-regulation cost estimated was made by MOE at lowest estimate submitted by companies, which was $500.

Company has notified MOE that it will likely recirculate its water, thereby eliminating its effluent stream, at a cost estimated at $6,000. Therefore, the company would not be subject to the requirements of the Regulation. Estimated cost saving to company is ($7,775 - $6,000) $1,775.

APPENDIX C-Continued
FACTORS AND ASSUMPTIONS CONSIDERED

A.H. Tallaman:

Company has notified MOE that it intends to convert to air cooling, at an estimated cost of $5,500, and will redirect discharge to sanitary sewers at an unknown cost.

MOE estimated cost of complying at $15,034. Estimate was calculated by doubling Magalloy's cost estimate for sampling, flow measurement, initial report and reporting, and adding the MOE estimate of $10,794 for routine monitoring.

A.H. Tallaman will have to meet any future requirements under the Sewer Use Control Program.

Pre-regulation cost estimate was made by MOE at lowest estimate submitted by companies, which was $500.

APPENDIX D

TRANSPORTATION COST ESTIMATE TO LAB BY COURIER

Based on estimates of courier transportation costs submitted.

Company	Toxicity	Sampling Points	Cost
Canron	yes	5	$3,600
Fahramet	yes	1	$680
Haley	yes	2	$4,000
		8	$8,280

Transportation cost per sampling point estimated by MOE at approximately $1,000.

Estimate used for those companies that did not submit a transport estimate, reguardless of whether the company faces a toxicity requirement.

Acustar estimate of $300 was not factored into calculation because the plant has no toxicity requirement and is located in Metro Toronto.

APPENDIX E

HALEY INDUSTRIES
COMPARISON OF TWO OPTIONS

Costs	1	2	SAVINGS
Sampling:			
-Operating	$14,000	$28,000	$14,000
-Capital	$12,000	$12,000	$0
Total Sampling	$26,000	$40,000	$14,000
Flow Measurement			
-Operating	$4,000	$8,000	$4,000
-Capital	$32,000	$32,000	$0
Total Flow Measurement	$36,000	$40,000	$4,000
Initial Report			
-Operating	$2,000	$4,000	$2,000
-Capital	$0	$0	$0
Total Initial Report	$2,000	$4,000	$2,000
Reporting			
-Operating	$6,000	$12,000	$6,000
-Capital	$6,000	$6,000	$0
Total Reporting	$12,000	$18,000	$6,000
Sub-Total	$76,000	$102,000	$26,000
Total Routine Monitoring	$95,048	$190,096	$95,048
Total Characterization	$3,984	$7,968	$3,984
Total Open Characterization	$3,400	$6,800	$3,400
Total Toxicity	$7,200	$14,400	$7,200
Total Cost to Plant For Monitoring Regulation	$185,632	$321,264	$135,632

1 - Assumes combined streams and one sample point.
2 - Assumes separate streams and two sample points.

Company provided cost estimate assuming one sampling point.

MOE assumed two sampling points until streams are actually combined.

APPENDIX F

TABLE F-1
SELECTED FINANCIAL STATISTICS
1982-1987
in 000's of Dollars

	1982	1983	1984	1985	1986	1987	Average
Bowmanville							
Net Income	N/A	($57)	$161	$97	$76	N/A	$69
Capital Expenditures	N/A	$1	$33	$32	$133	N/A	$50
Canron Inc.							
Net Income	($33,937)	$2,670	$6,550	$11,489	$15,080	N/A	$370
Capital Expenditures	$5,467	$7,488	$21,518	$11,241	$14,905	N/A	$12,124
Chrysler U.S.(in $U.S. millions)							
Net Income	$170	$701	$2,373	$1,610	$1,389	$1,290	$1,256
Capital Expenditures	$374	$1,058	$1,247	$1,535	$2,061	$1,936	$1,369
Falconbridge							
Net Income	($85,254)	($18,358)	$28,694	$38,543	($15,518)	$29,697	($4,439)
Capital Expenditures	$17,317	$24,321	$52,683	$43,476	$106,658	N/A	$48,891
Franklin U.S.(in $U.S. thousands)							
Net Income	N/A	$5,500	$5,800	$4,700	$6,200	$8,100	$6,060
Capital Expenditures	N/A	$4,166	$4,712	$5,262	$2,392	$4,074	$4,121

Source: Company consolidated annual reports and Financial Post Information Service.

APPENDIX F

TABLE F-1 (continued)
SELECTED FINANCIAL STATISTICS
1982-1987
in 000's of Dollars

	1982	1983	1984	1985	1986	1987	Average
Ford							
Net Income	($107,800)	$119,900	$299,500	$199,000	$101,100	N/A	$122,340
Capital Expenditures	$229,600	$254,700	$246,300	$295,800	$426,400	N/A	$290,560
General Motors							
Net Income	($71,686)	$675,570	$880,764	$712,975	$418,415	N/A	$523,208
Capital Expenditures	$324,105	$342,070	$267,472	$674,492	$1,318,262	N/A	$585,280
Haley							
Net Income	$2,105	$2,015	$3,029	$4,252	$6,442	$3,303	$3,524
Capital Expenditures	$2,163	$877	$324	$1,137	$4,243	$3,830	$2,096

Source: Company consolidated annual reports and Financial Post Information Service.

APPENDIX G
TABLE G-1
REGULATION OPERATING COST IMPACT ON NET INCOME
in 000's of Dollars

	NET INCOME			OPERAT			
	HIGH	LOW	AVERAGE	EXPEND	%HIGH	%LOW	%AVERAGE
Bowmanville	$161.0	($57.0)	$69.0	$8.7	5.404%	-15.263%	12.609%
Canron	$15,080.0	($33,937.0)	$370.0	$52.5	0.348%	-0.155%	14.189%
Chrysler U.S.($U.S. millions) (1) ($C=.83$U.S. applied to operating cost estimate)	$2,373.0	$170.0	$1,256.0	$0.010	0.000%	0.006%	0.001%
Falconbridge (2)	$38,543.0	($85,254.0)	($10,379.0)	$16.5	0.043%	-0.019%	-0.159%
Franklin U.S. (3) ($C=.83$U.S. applied to operating cost estimate)	$8,100.0	$4,700.0	$6,060.0	$13.6	0.168%	0.289%	0.224%
Ford	$299,500.0	($107,800.0)	$122,340.0	$316.1	0.106%	-0.293%	0.258%
General Motors	$880,764.0	($71,686.0)	$523,208.0	$200.1	0.023%	-0.279%	0.038%
Haley(2 sampling points)	$6,442.0	$2,015.0	$3,524.0	$271.3	4.211%	13.464%	7.699%
Haley(1 sampling point)	$6,442.0	$2,015.0	$3,524.0	$135.6	2.105%	6.730%	3.848%

NOTES:

Operat Expend = Estimated operating expenditures to comply with Regulation.

SOURCE: Company consolidated annual reports and Financial Post Information Service.

(1) Consolidated Chrysler U.S. financial data were used for Acustar Canada Inc.

(2) Consolidated Falconbridge financial data were used for Fahramet Steel Castings Indusmin Division.

(3) Consolidated Franklin U.S. financial data were used for Franklin Electric of Canada Ltd.

APPENDIX H
TABLE H-1
IMPACT OF REGULATION CAPITAL EXPENDITURES
in 000's of Dollars

Capital Expenditures	HIGH	LOW	AVERAGE	REG	%HIGH	%LOW	%AVERAGE
Bowmanville	$133.0	$1.0	$50.0	$0.1	0.075%	10.000%	0.200%
Canron	$21,518.0	$5,467.0	$12,124.0	$2.2	0.010%	0.040%	0.018%
Chrysler U.S.($U.S. millions (1) ($C=.83$U.S. applied to Reg estimate)	$374.0	$2,061.0	$1,369.0	$0.017	0.005%	0.001%	0.001%
Falconbridge (2)	$106,658.0	$17,317.0	$48,891.0	$6.6	0.006%	0.038%	0.013%
Franklin U.S. (3) ($C=.83$U.S. applied to Reg estimate)	$2,392.0	$5,262.0	$4,121.0	$1.9	0.079%	0.036%	0.046%
Ford	$426,400.0	$229,600.0	$290,560.0	$180.0	0.042%	0.078%	0.062%
General Motors	$1,318,262.0	$267,472.0	$585,280.0	$238.0	0.018%	0.089%	0.041%
Haley	$4,243.0	$877.0	$2,096.0	$50.0	1.178%	5.701%	2.385%

NOTES:

Reg = Estimated capital requirement to comply with Regulation.

SOURCE: Company consolidated annual reports and Financial Post Information Service.

(1) Consolidated Chrysler U.S. financial data were used for Acustar Canada Inc.

(2) Consolidated Falconbridge financial data were used for Fahramet Steel Castings Indusmin Division.

(3) Consolidated Franklin U.S. financial data were used for Franklin Electric of Canada Ltd.

APPENDIX I

TABLE I-1
IMPACT OF OPERATING COST ON RETURN ON CAPITAL EMPLOYED
in 000's of Dollars

Bowmanville	1982	1983	1984	1985	1986	1987	Average
Capital Employed	N/A	$746	$907	$1,004	$1,080	N/A	$934
ADJ operating	-	$4.7	$4.7	$4.7	$4.7	-	$4.7
Dif ROCE	-	-0.63%	-0.52%	-0.47%	-0.44%	-	-0.50%
(tax =46%)							
Canron Inc.							
Capital Employed	$122,255	$151,344	$158,567	$189,023	$195,463	N/A	$163,330
ADJ operating	$28.4	$28.4	$28.4	$28.4	$28.4	-	$28.4
Dif ROCE	-0.02%	-0.02%	-0.02%	-0.01%	-0.01%	-	-0.02%
(tax =46%)							
Chrysler U.S.(in $U.S. millions)							
Capital Employed	$1,859	$2,230	$4,042	$6,532	$7,615	$9,836	$5,352
ADJ operating	0.0006%	0.0006%	0.0006%	0.0006%	0.0006%	0.0006%	0.0006%
Dif ROCE	-0.0000003%	-0.0000003%	-0.0000002%	-0.0000001%	-0.0000001%	-0.0000001%	-0.0000001%
(tax =37%)							
Falconbridge							
Capital Employed	$871,914	$958,706	$919,836	$1,070,155	$2,427,420	N/A	$1,249,606
ADJ operating	8.9	8.9	8.9	8.9	8.9	-	8.9
Dif ROCE	-0.0010%	-0.0009%	-0.0010%	-0.0008%	-0.0004%	-	-0.0007%
(tax =46%)							
Franklin U.S. (in $U.S. thousands)							
Capital Employed	N/A	$70,600	$73,300	$57,600	$62,000	$68,000	$66,300
ADJ operating	-	$9	$9	$9	$9	$9	$9
Dif ROCE	-	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%
(tax =37%)							

APPENDIX I
(continued)
TABLE I-1
IMPACT OF OPERATING COST ON RETURN ON CAPITAL EMPLOYED
in 000's of Dollars

Ford	1982	1983	1984	1985	1986	1987	Average
Capital Employed	$786,700	$856,600	$1,138,200	$1,082,100	$1,179,300	N/A	$1,008,580
ADJ operating	$170.7	$170.7	$170.7	$170.7	$170.7	-	$170.7
Dif ROCE (tax =46%)	-0.02%	-0.02%	-0.01%	-0.02%	-0.01%	-	-0.02%
General Motors							
Capital Employed	$803,773	$1,479,343	$1,760,094	$2,230,026	$2,432,125	N/A	$1,741,072
ADJ operating	$108.1	$108.1	$108.1	$108.1	$108.1	-	$108.1
Dif ROCE (tax =46%)	-0.01%	-0.01%	-0.01%	0.00%	0.00%	-	-0.01%
Haley							
Capital Employed	$13,486	$14,720	$19,031	$19,031	$23,449	$23,091	$18,801
ADJ operating(samp 2)	$146.5	$146.5	$146.5	$146.5	$146.5	$146.5	$146.5
ADJ operating(samp 1)	$73.2	$73.2	$73.2	$73.2	$73.2	$73.2	$73.2
Dif ROCE(samp 2)	-1.09%	-1.00%	-0.77%	-0.77%	-0.62%	-0.63%	-0.78%
Dif ROCE(samp 1) (tax =46%)	-0.54%	-0.50%	-0.38%	-0.38%	-0.31%	-0.32%	-0.39%

NOTES:

Dif ROCE = Difference to Return On Capital Employed resulting from Regulation operating costs.
ADJ operating = Estimated operating cost of Regulation adjusted for tax and currency valuation.

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